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Men, Methods and Machinery of Modern Management

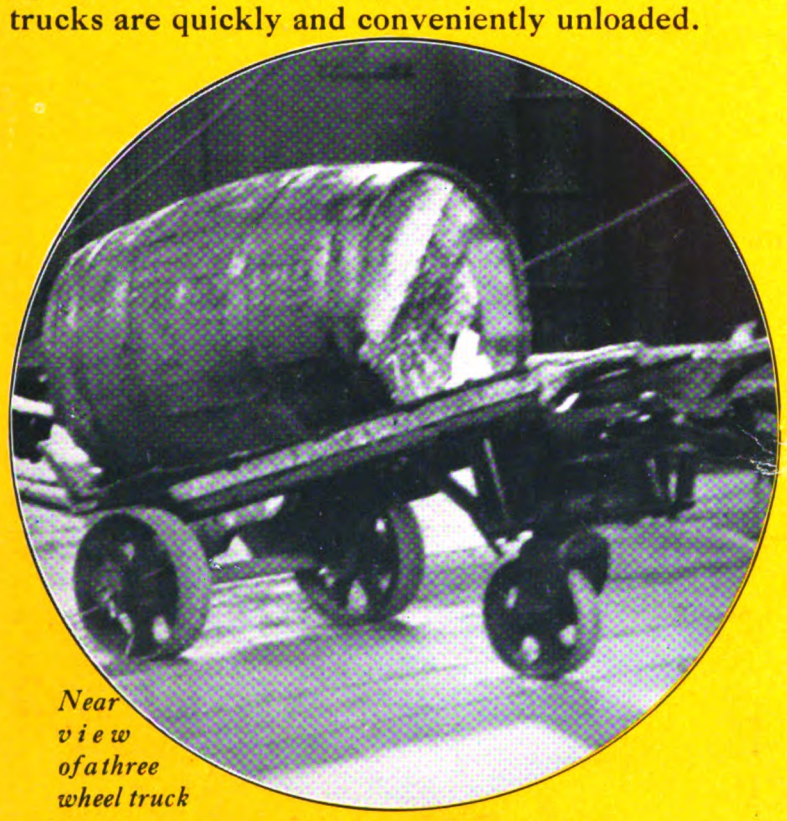
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Economical Handling of Barrels and Drums

Cedar Hill Terminal of New York, New Haven & Hartford Uses a New Type of Truck Built by Lansing Company and Completely Hyatt Bearing Equipped

For the economical handling of barrels and drums the New York, New Haven & Hartford Railroad is using a new type of three wheel truck evolved by the Lansing Company. This is a two wheel truck with a caster wheel between the handles.

The new three wheel truck is loaded just as any two wheel truck, and is then dropped until the caster wheel rests on the floor. The loaded trucks coupled together form a train of trailers that is rapidly hauled by a tractor. Arriving at their destination the trucks are quickly and conveniently unloaded.

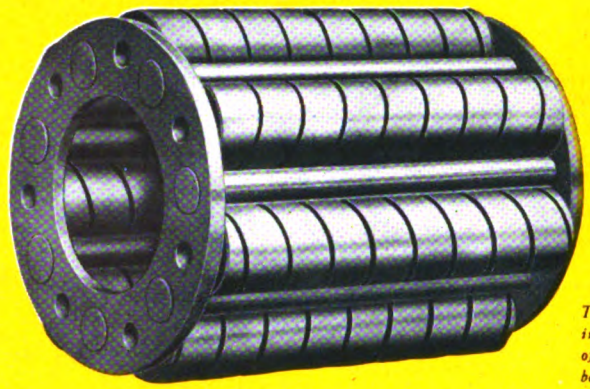


Near view of a three wheel truck

The new trucks are equipped throughout with Hyatt roller bearings, making them easy to move either by hand or as trailers and insuring their dependable operation for years without necessity of bearing adjustments or replacements.

Whatever improvements are contemplated in your trucking systems it will pay you to give careful consideration to the bearings. The use of Hyatt roller bearings makes possible material handling at the lowest cost per ton because of their easy running, their lubrication saving and their durability.

The rollers of the Hyatt bearing provide a true rolling motion in place of the rubbing friction of plain bearings, so that one man can handle twice as heavily loaded trucks without extra exertion and tractors can pull more trailers per train.



The easy rolling element of the Hyatt bearing.

The bearings are enclosed in the wheel hubs, providing a space for lubricant which need be replenished only three or four times a year—a real saving in oil and labor.

The tough, resilient steel rollers are designed to operate correctly without appreciable wear even after years of hardest service.

Whatever type or make of trucks you are using, these advantages can be secured by specifying that they be Hyatt equipped. Practically all representative truck manufacturers are in a position to furnish their trucks equipped with Hyatt roller bearings.

Hyatt Roller Bearing Co., New York, N. Y.
Industrial Bearings Division

Motor Bearings Division, Detroit
Tractor Bearings Division, Chicago

USE HYATT BEARINGS ON YOUR LINE SHAFTS TOO BULLETIN 127

Pacific Coast Division
San Francisco



This is the way they haul barrels at the Cedar Hill terminal of the New York, New Haven & Hartford on three wheel trucks equipped with Hyatt roller bearings and made by the Lansing Company.

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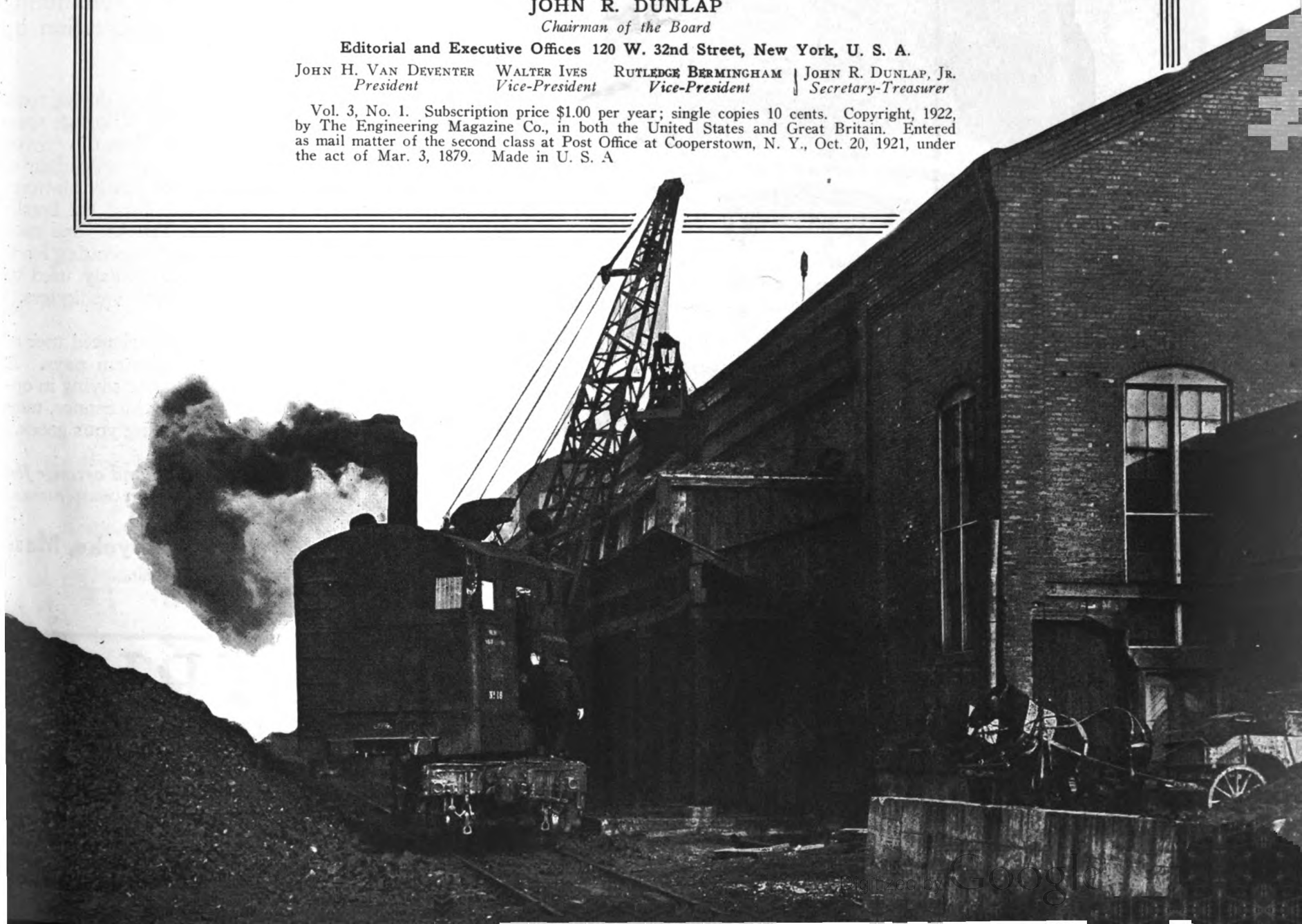
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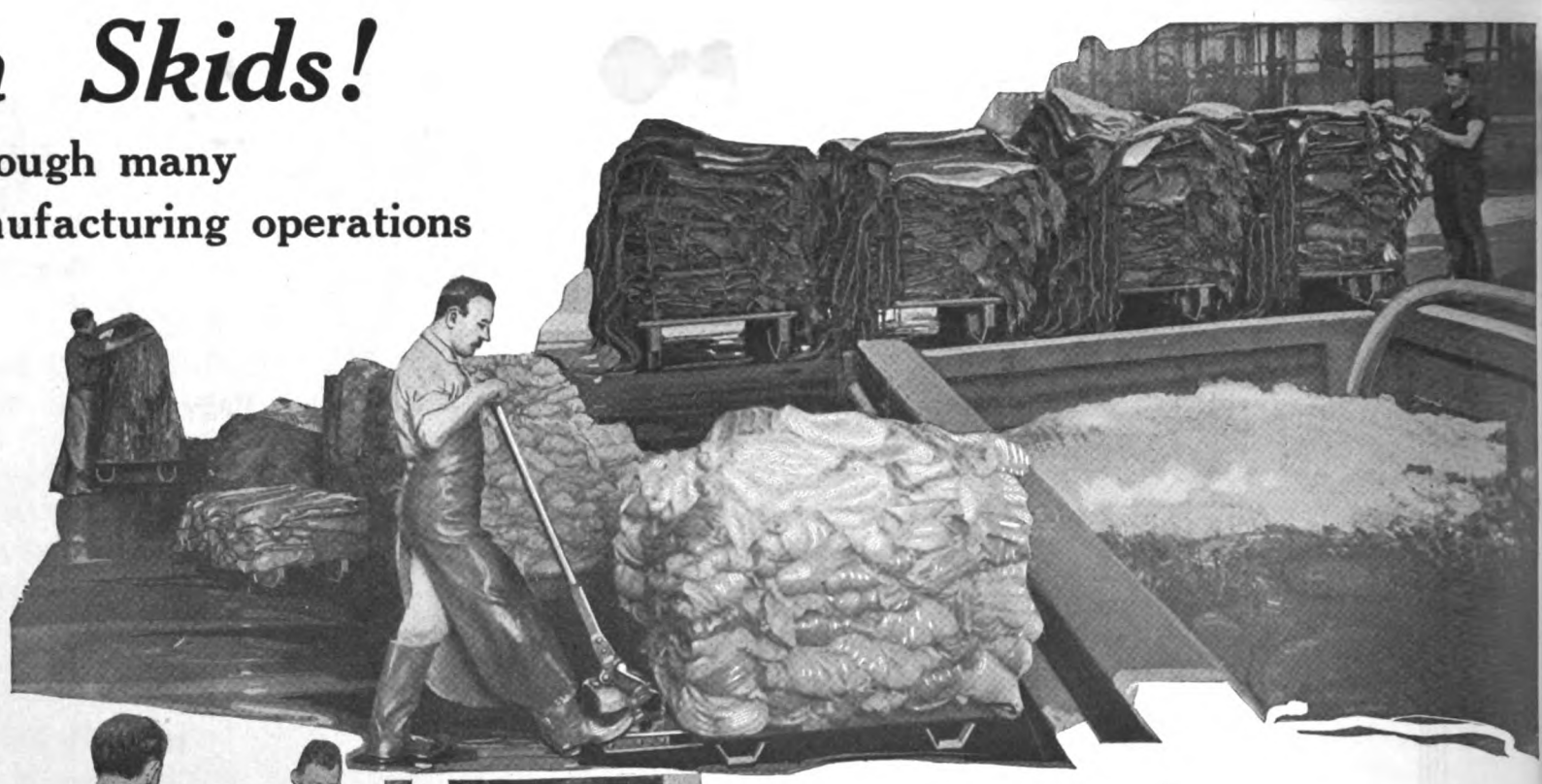
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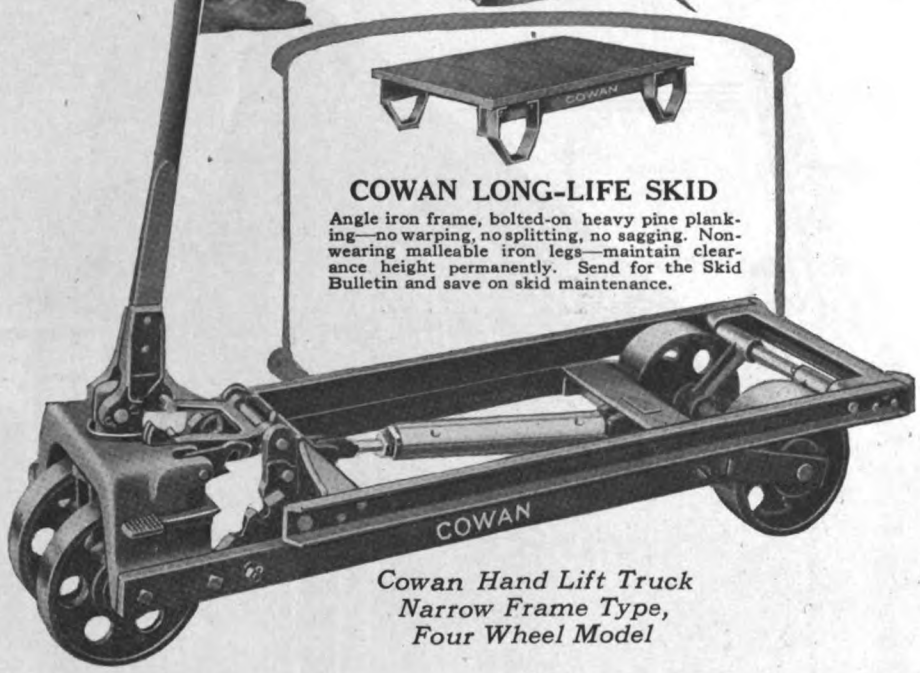
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On Skids!

Through many manufacturing operations







COWAN LONG-LIFE SKID

Angle iron frame, bolted-on heavy pine planking—no warping, no splitting, no sagging. Non-wearing malleable iron legs—maintain clearance height permanently. Send for the Skid Bulletin and save on skid maintenance.

Cowan Hand Lift Truck
Narrow Frame Type,
Four Wheel Model

Cowan Trucks and Skids Cut Handling Costs

In the big factory of the Max Hertz Leather Co., Newark, N. J., superfluous labor costs are cut by skidding the loads whenever possible, thereby largely eliminating rehandling and ensuring easy, rapid transportation by hand lift trucks.

All the way through—from tanning vats to drying room—the hides move, on inexpensive skids. Through special machines they pass, off of one skid, then directly on to another. Practically no loading and unloading at each transfer. No large equipment of costly platform trucks. Inexpensive skids and a few hand lift trucks replace them. Cowan Hand Lift Trucks—one man hauling and automatically lifting and depositing loads weighing hundreds of pounds—are extensively used to handle these heavy burdens, reeking with vat liquors.

The Hertz Company is a large and experienced user of lift trucks and skids—they know the system pays. A skid and lift truck system, time and labor saving in operation, economical in first cost and maintenance, may mean even bigger cost cutting in handling your goods.

We shall be glad to send a Bulletin now and arrange for a study of your plant conditions at your convenience.

Cowan Truck Co., 6 Water St., Holyoke, Mass.

New York Office: Grand Central Palace

Offices in Principal Cities

COWAN INDUSTRIAL TRUCKS-TRACTORS

Originators *of the* "through ticket" *system for* moving loads

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"I took this chance and Won!"

"Jim, old man, how did you ever put it over?" It was after business hours, and Perkins---who asked the question---had stepped into the office of the newly appointed General Manager for a talk.

Perkins was sore. Until recently, both Edmonds and he had been Department Managers for the J. J. Black Manufacturing Company. But something had happened during the week just past to change all this. The former General Manager unexpectedly resigned. The Board of Directors met to appoint a successor. Edmonds got the job.

Perkins was stunned. Not because he had expected to get the position himself, but because he didn't see why Edmonds had landed it. He was frankly curious.

"Jim, old man, how did you ever put it over?"

Getting Out of a Rut

And then Edmonds told him. "Perkins, you and I were both doing the same kind of work. We knew our respective departments pretty thoroughly, but right there our knowledge stopped. We were strictly "one department men," and as such, our value to the Company was limited.

"We both worked pretty hard but we didn't seem to get ahead. We seemed to have found our level —it was just high enough to keep us from becoming discontented.

"But one year ago I woke up. An advertisement did the trick. It was a Home Study Course Advertisement—but not the usual kind. This advertisement offered me a Course of Study in Industrial Engineering and Factory Management. As a Factory trained man it appealed to me at once as an intensely practical course. It told me in plain fashion what I wanted to know.

A New Kind of Training

"I saw a chance to train myself, during my spare time, in the fundamentals of big business—a chance to study the basic principles which govern factory organization and administration, the selection and layout of buildings and equipment, the planning and routing of work, wage systems and bonus plans, cost accounting, the generation and use of power, the valuation of property, statistical control and all other factors which are conducive to maximum production at minimum expense.

"I acted then and there. I took this chance and won."

Thousands of factory trained men, among whom are presidents, general managers, superintendents, industrial engineers, foremen, cost clerks, accountants, storekeepers, inspectors and plain, every day workers at the bench have seized the same opportunity which came to Edmonds, and have been helped to bigger jobs and better salaries by enrolling in the "Factory Management Course and Service" offered by the Industrial Extension Institute.

An Organized Course of Study

This remarkable course is the only one of its kind in the world. It is a practical, non-technical course for the practical factory man. It is based on the University plan of organized study, consisting of lectures, talks, reading assignments, text books, problems and model solutions to these problems. The Consulting service, which is part of the Course, is intended to help you meet and solve the questions which arise in your daily business.

No University has been able to present a Course like this one. It would be impossible to hire as teachers the sixty prominent industrial specialists who have personally cooperated to produce the Factory Management Course and Service. The combined experience of men like Gantt, Towne, Babson, Ficker, Steinmetz, Franklin, Going etc., each a recognized expert in his own particular field—has been systematically arranged and presented in plain, understandable language so that you can profit by it.

You will understand what men at the top think about the "Factory Management Course and Service" when we tell you that 35 per cent of the last 1000 men to enroll were managing executives. This does not include any man below the position of superintendent.

Wanted—The $20,000 Man

The demand for men trained in industrial management is far greater than the supply. Big business is literally begging for the man who can hold down a $20,000 job.

Show your will power! Make up your mind to get out of the rut of routine and begin *now* to prepare yourself for a bigger, broader job.

The man who studies this course conscientiously will quickly qualify for greater responsibilities, and, what is much more important, he will find his qualifications recognized and the responsibilities thrust upon him.

You have read this advertisement. Now take the chance it offers you. Tear off the coupon below and send for:

"Thinking Beyond Your Job"

—the interesting 100 page booklet that tells you, without any obligation on your part, everything you want to know about the Factory Management Course and Service.

INDUSTRIAL EXTENSION INSTITUTE
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Send me without obligation your 100 Page Book "Thinking Beyond Your Job."

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PUT ENERGY AND EFFICIENCY
in your heating system, with the economical
JENNINGS HYTOR

Now is the time to prepare your heating facilities to meet the conditions of the coming winter.

The installation of a Jennings Return Line Pump in connection with your system means quick heat in the morning, at the most isolated radiators, and in zero weather. It means a positive control of heat at all times and the elimination of radiator noises. It means an economy in fuel, that, according to our customers, makes this piece of equipment a real dividend paying proposition.

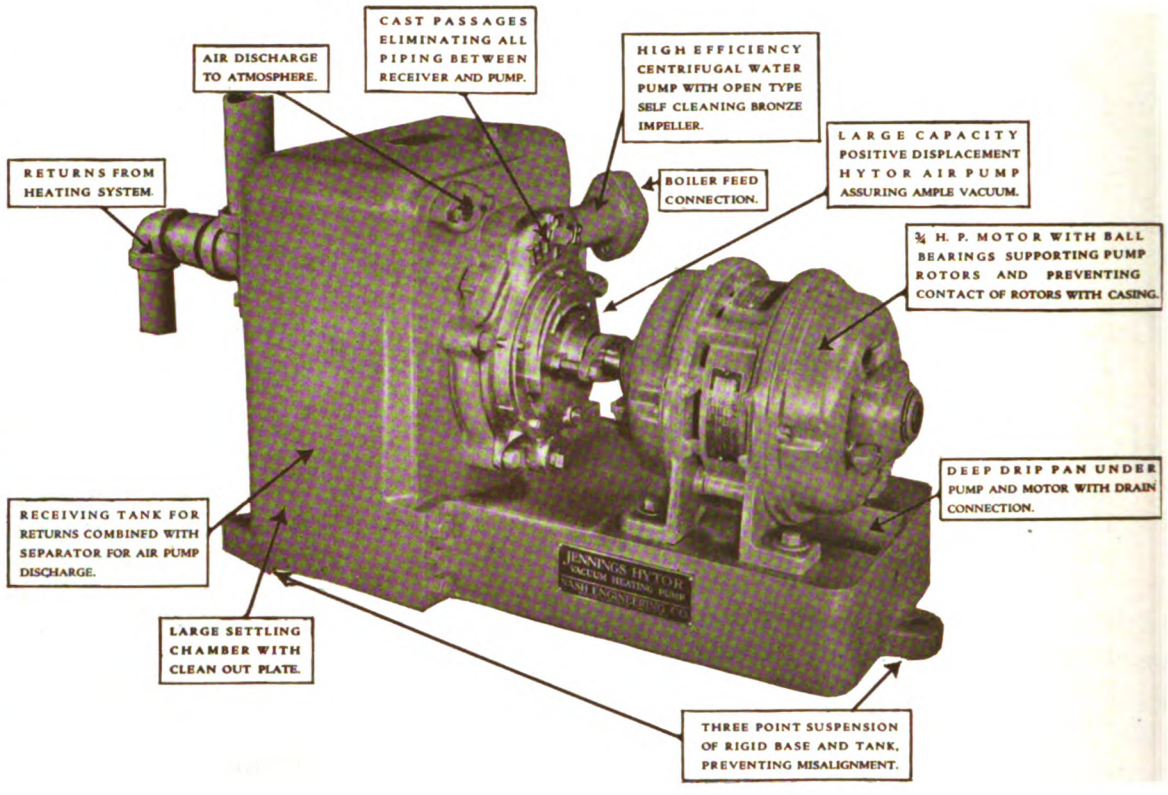
Jennings Pumps are made for any size installation. The small unit here illustrated has ample capacity of 5,000 sq. ft. of equivalent direct radiation. Because of simplified design, in connection with quantity production, this outfit is being sold at a price never before possible in a pump of this capacity.

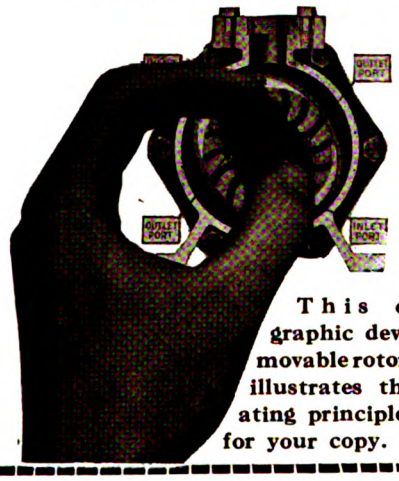
The pump incorporates all of the high grade workmanship and material characteristic of our Jennings equipment. It is equipped with solid bronze air rotor, rotor housing, water impeller and shaft.

In this unit all piping complications have been removed, and it is only necessary to make three connections:

1. The return main.
2. The water discharge.
3. The air discharge.

Write for Bulletin and Prices

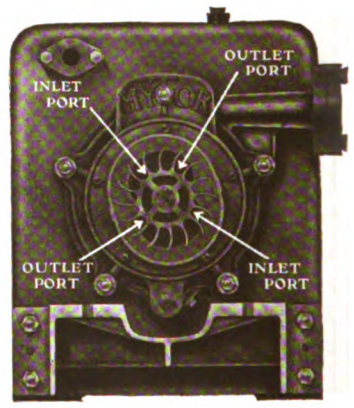


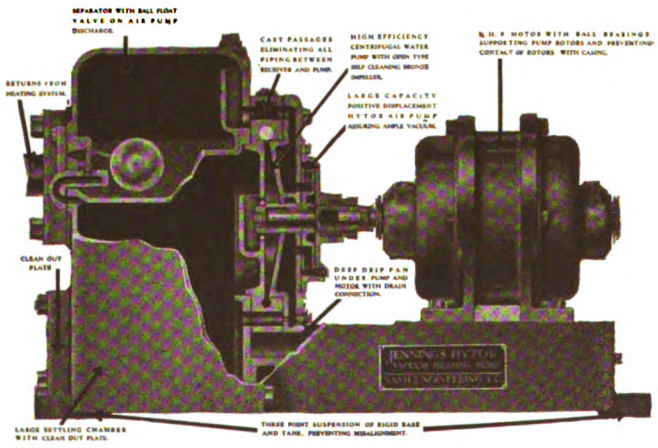


This celluloid graphic device with movable rotor clearly illustrates the operating principle. Send for your copy.

The air capacity is 3 cubic feet per minute, measured at 10" of mercury vacuum. The pump at the same time handles 8 gallons of water per minute from a vacuum of 10" of mercury against 10 lbs. gauge pressure at the pump. Under these conditions the pump requires ¾ h.p. motor.

In this pump a positive displacement vacuum pump with high efficiency exhausts air only, while the centrifugal pump element handles only the condensate. In thus separately handling air and water in a predetermined ratio, such high efficiency is effected that no other pump can be secured of equal capacity for similar service with the same minimum horse power requirements.





While the new compact "M" type is furnished in one size, our well known Jennings Pumps in separate tank design, as recommended for larger capacities, are furnished for any size installation.

Many thousands of these pumps have been installed and have given universal satisfaction.

An important feature of these pumps is the very large air volume, as compared with their capacity rating, which assures ample vacuum.

As the horse power required is considerable less than for any other pump in the market of the same *rating*, regardless of the actual *volume*, the result is very low electric current cost. This, coupled with the extreme durability of these units, make them the most economical return line heating pump it is possible to install.

4

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SOUTH NORWALK, CONN., U.S.A.

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EDITORIAL

Inventions and Progress

IN the city of Strassbourg is a world-famous clock which not only tells the time of day, but presents a procession of life-size figures of the Apostles, gives the seasons, phases of the moon, and a number of other interesting things. This clock, as it stands today, was re-constructed in 1842. It was originally designed and built, however, by a mathematician named Conrad Dasypodius in the year 1574.

Legend has it that when this wonderful clock was completed, the City Fathers of that time were not only struck by the marvellous creation, but they were possessed of a jealous fear that some other city might one day obtain another like it. So they destroyed the eyesight of Dasypodius, that he might never construct another such clock.

We are told, further, that a short while afterward something went wrong with the clock. They appealed to the blind inventor, who assured them that, even without his sight, he could repair his beloved mechanism. They led him there, and he, with a sense of poetic justice, managed so to disarrange the mechanism that it ceased to function at all. And it was more than two hundred and fifty years before a genius could be found equal to the task of repairing the damage.

In all Europe during that time there were probably not a handful of men who could have studied that mechanism intelligently enough to restore it. Travel and means of communication were slow. The artisan in Holland or Germany would learn of new discoveries or developments in places a few hundred miles away only many months after they had taken place. Education was for the very few; books were rare and costly. The great mass of the people could neither read nor write, and had no opportunity to familiarize themselves with inventions.

We call the present the age of machinery or the age of invention. We marvel at the intricate and wonderful creations the mind of man has conceived and brought into being. Figuratively speaking, we pat ourselves on the back for being so far ahead of those old fellows of centuries ago; those generations of men who failed to see the germ of a tremendous idea in Hero's turbine; who did not appreciate the value of machinery, and let so many inventions die for lack of that appreciation.

Yet, with our infinitely higher standard of mass education, with our infinitely better opportunities for gaining specialized knowledge, and with our infinitely quicker means of travel and communication, the wonder lies not in these things themselves, but in the fact that so many of us fail to take advantage of them.

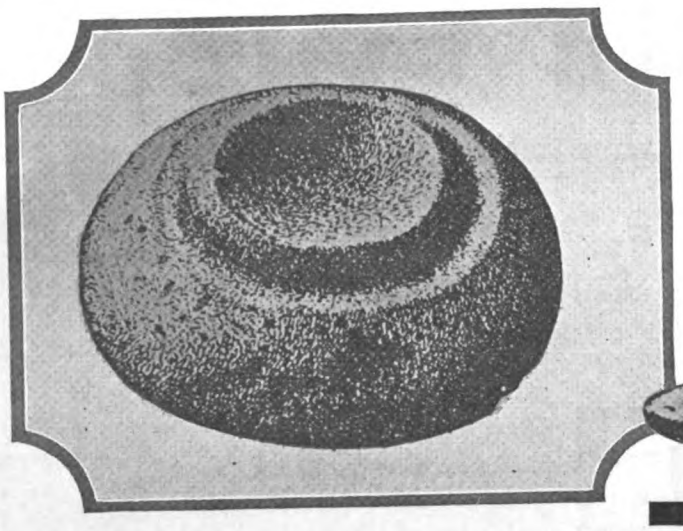
Knowing that machinery is superior in every way to man-power for the heavy work of the world, we still go on wasting men and money through antiquated methods. Knowing that coal contains products many times more valuable than its mere heat as a fuel, we continue to burn up these products as fuel.

We expect much of our inventors. Doubtless the next decade will see some revolutionary inventions. But what we need is not so much new inventions and discoveries. What is needed is a better and more universal use of those already at hand.

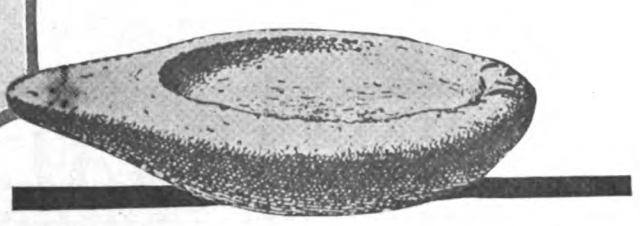
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Lights of the

BY H. H



A stone lamp probably twenty thousand years old.



A sand-stone lamp estimated to be fifteen thousand years old.

AT THE opening of th present century when th discoveries of prehistoric cave in Northern Spain and South ern France followed one upo another, it was found that eve the inmost recesses of windin and complicated caverns wer decorated with paintings animals, several of which a now extinct. The question once arises, what light did th cave dwellers use to enabl them to do this painting?

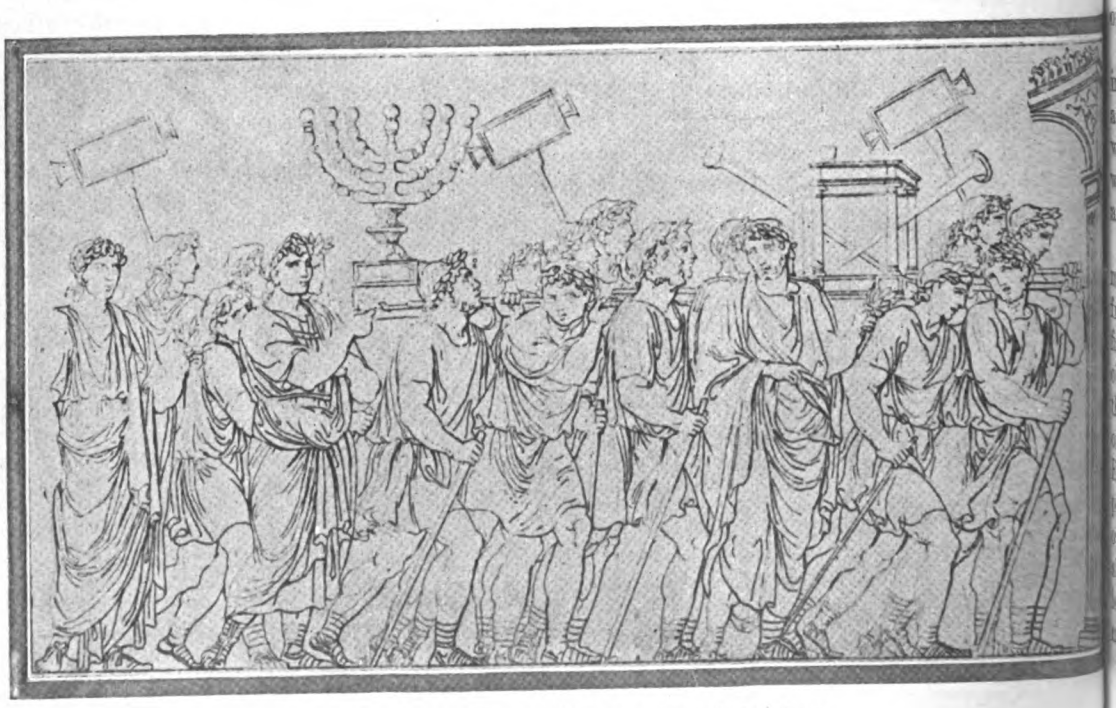
At first it was supposed th they had only firebrands, dried wood, or rushes, and n doubt they did employ thes materials. But one by one ho lowed stones were discovere which it was seen might hav been used to hold fat to b burned as a light. At la one was unearthed in the ca of La Mouthe which still co tains traces of ashes adherin to it, which on a chemic analysis proved to be like thos from the burning of animal fa such as lard or tallow, that ha not previously been separate from its membranes. The co sensus of opinion is that th must have been the lamp the time.

As these caves belong to t glacial period, some twen thousand years ago, the sto lamp was in existence at th almost unbelievably dista date. It was used in the epo



Ancient Egyptian lantern, from three to four thousand years old.

The ancient Egyptian lamp with two bowls connected by a tube; used in worship.

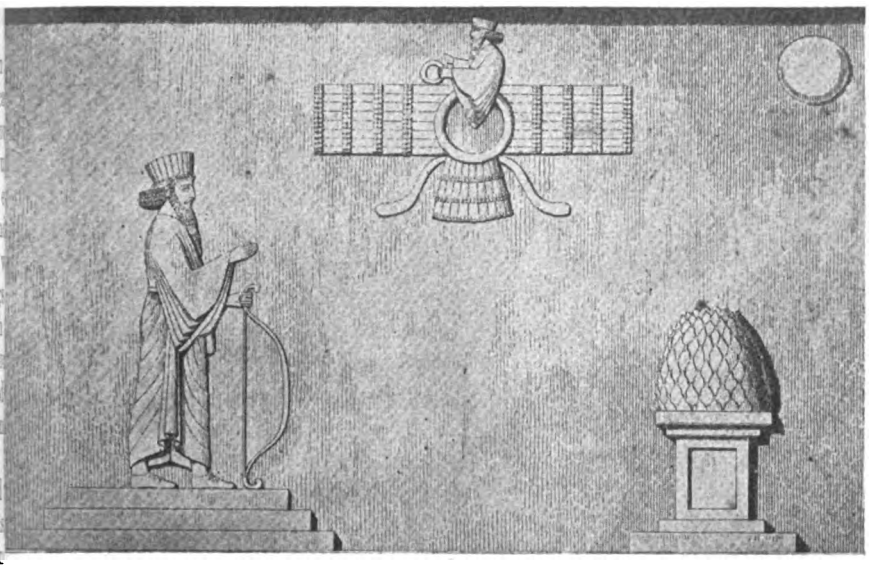


The Seven-Pronged Candelabra of the Jews. (See text.)

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Dim Past

MANCHESTER



The Persian fire altar, used with the eternal fires, at Baku.



Lamps of the Ancient Assyrians.

of the sabre-toothed tiger, of the mammoth, and cave bear, when the reindeer herded on the edge of the ice field in Spain. It is older than agriculture, or bread making, or pottery, or weaving. Its importance to that time was no doubt increased by the very fact that the race dwelt in caves. Perhaps it made possible the production of the wall frescoes, the astonishing discovery of which has created an epoch in our knowledge of the past.

Some of the stone lamps of that age were like small, shallow bowls, a few of which have a hollowed ring around the rim. In other cases they are not much more than nodules of stone with a hollow rubbed out of one side.

Perhaps an attempt at an improvement may be seen in a sandstone lamp, one side of which is fashioned to a point, which gives the impression of an uncovered spout.

The fuel, as we have intimated, was no doubt the fat from the animals or even the fish of the period, for vegetable oils were not yet obtainable in that cold climate, and mineral oils were of course unknown. Even this crude lamp was probably a great improvement over the firebrand for use inside the cave, as it produced less smoke, and the fuel was more concentrated.

Whether a wick was used is

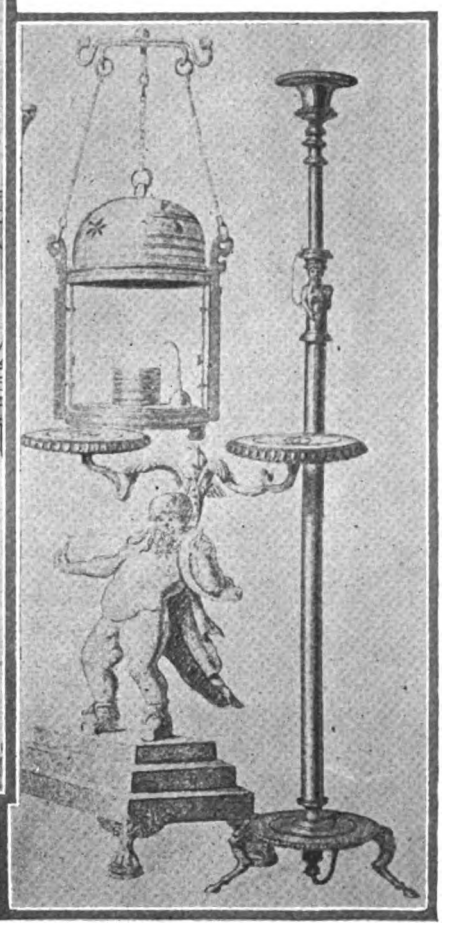
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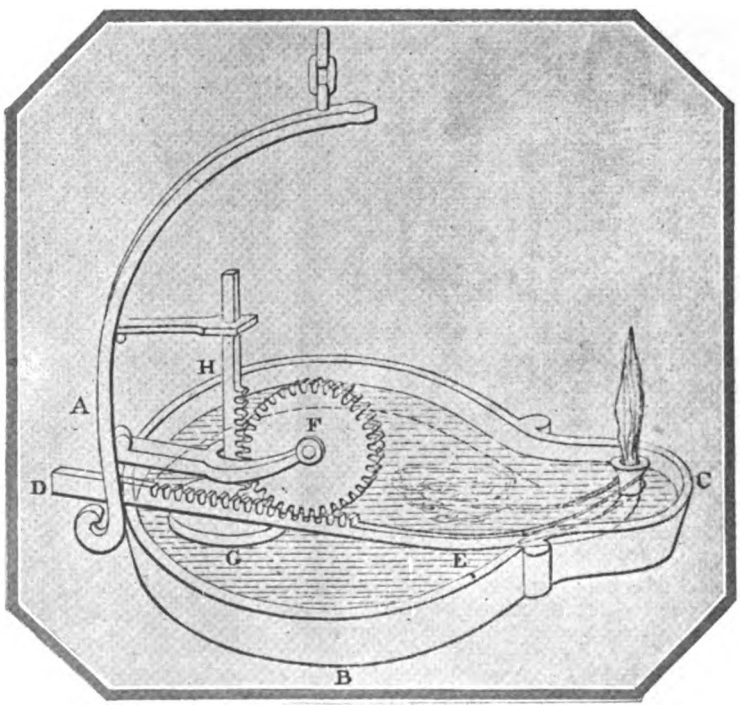
Greek lamp-protectors, 2400 years old.



The earliest known illustration of a candle, from an Etruscan sarcophagus, about 700 B. C.



Some Pompeian Candelabra, giving evidence of more elaborate design.



Our friend Hero, the geometer, who designed a steam turbine, also designed this self-regulating lamp and wick—about nineteen hundred years ago, perhaps more.

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The Making of a Filament Lamp

Quantity Production Methods That Have Brought Edison's Invention Within the Reach of All

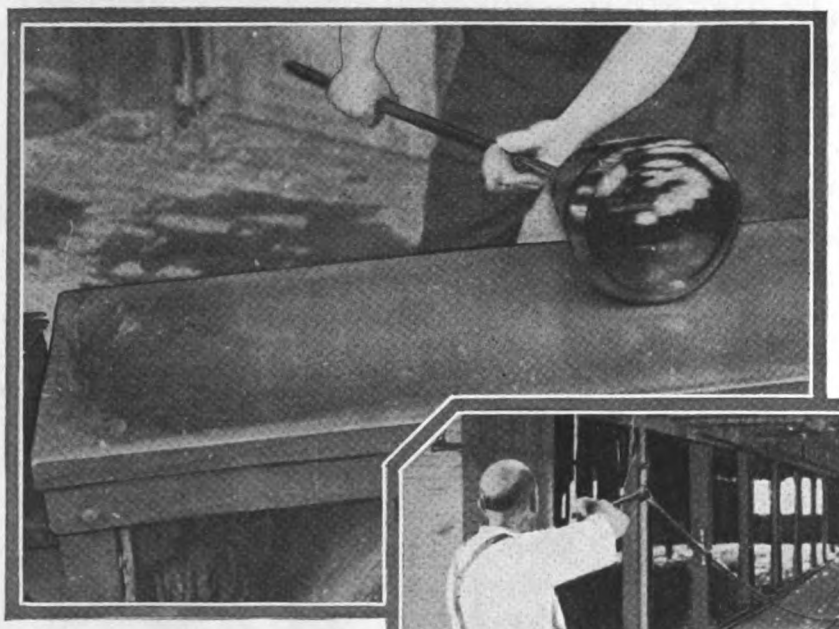
By J. M. Hickerson



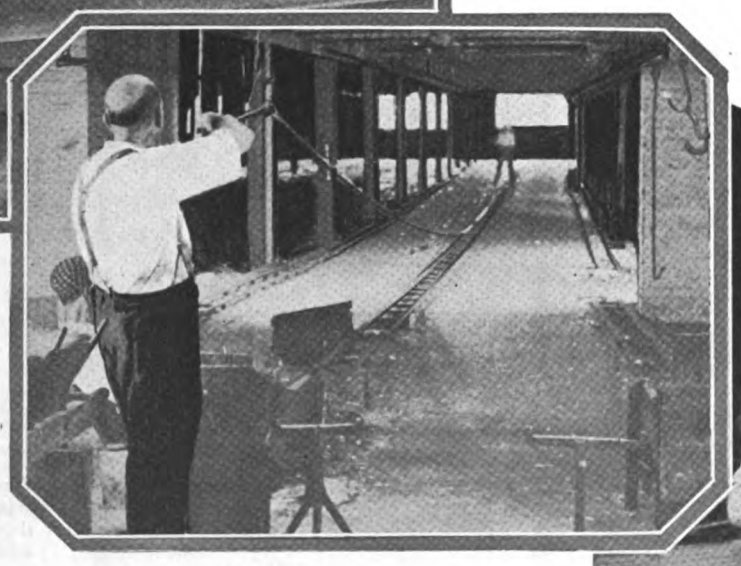
At the glass factory the glass-to-be is melted in clay pots at a temperature of 2500 degrees F. Making these clay pots is in itself a tedious and expensive operation.



Silica sand, Nature's form of glass, is found as soft sandstone. It is crushed and pulverized at the quarry and then shipped to the glass factory to be washed and mixed with other ingredients to make various lamp parts.



The molten glass is removed from the clay pots on the blow pipe and is rolled on a "marvering plate" to properly distribute it about the end of the blow pipe. Then it is blown and drawn into hollow tubing for use in lamp making.



At the right—Glass blower and helper drawing tubing. The sphere of molten glass shown above is here drawn into the hollow tube from 150 to 200 feet long in No. 4. It cools on an endless roller which automatically cuts it into lengths convenient for handling.



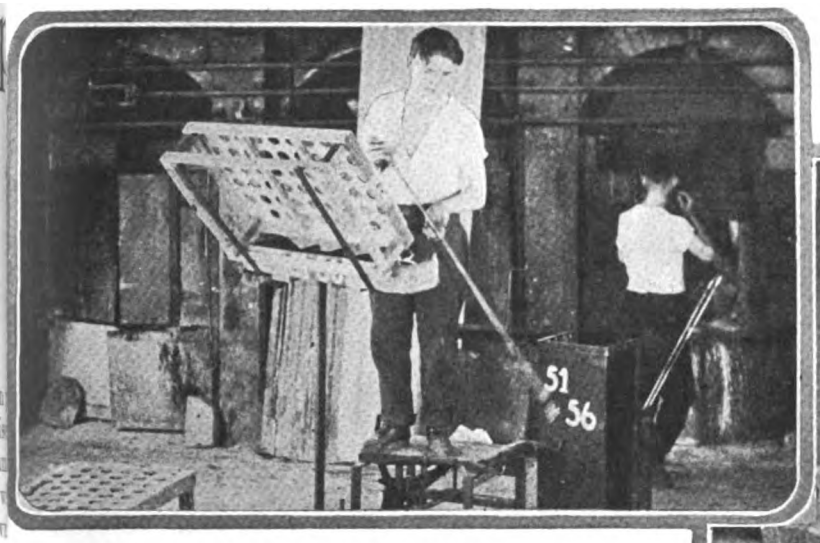
At the right—Inspecting tubing for flaws and sorting it as to the outside diameter and thickness of wall.

NO ONE knows when in pas ages some savage discov ered fire and use a flamin torch to light his cave whe twilight fell. Coming down t recent times, however, gas wa widely used for illuminatio purposes in the eighteenth century, and was known to me of science several centurie earlier. But it was not unti the close of the nineteenth cen ury that the period of safety reliability, convenience an economy in artificial illumina tion was ushered in with th commercial development of th incandescent electric lamp.

Distant India, Spain and th Malay Peninsula furnish som of the ingredients of incande cent lamp parts; others com from Greenland, Canada, Chi and a dozen or more of th United States; and yet other are taken from the air. Thes thirty-odd materials go throug many processes in the manu facture of glass, wire, an brass bases, which are the thre major parts of a tungsten fila ment incandescent lamp.

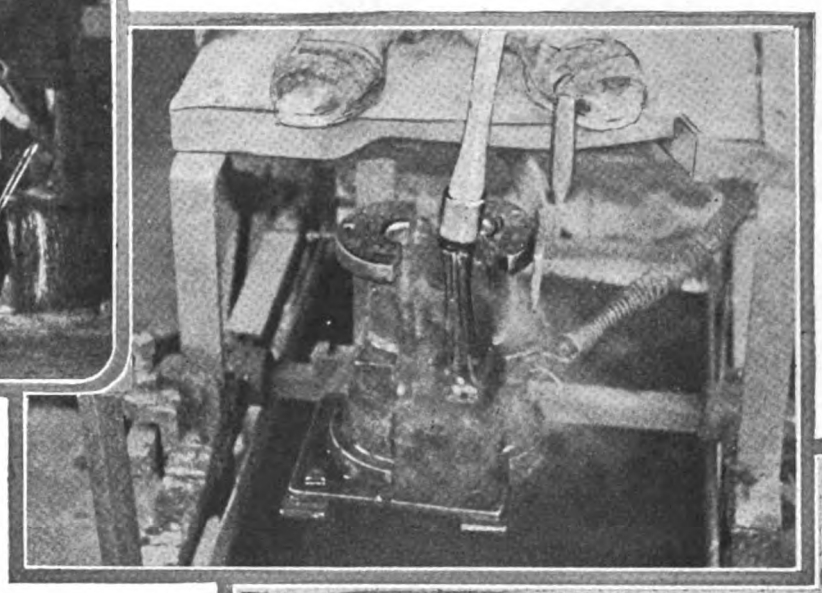
Nature's form of glass i silica sand which is found i the form of soft sandston This is quarried, crushed an pulverized, and shipped to th glass factory as fine sand. A the factory certain ingredient are added to this sand—som to form a vehicle which, lik water added to sugar, assist in the melting of the sand

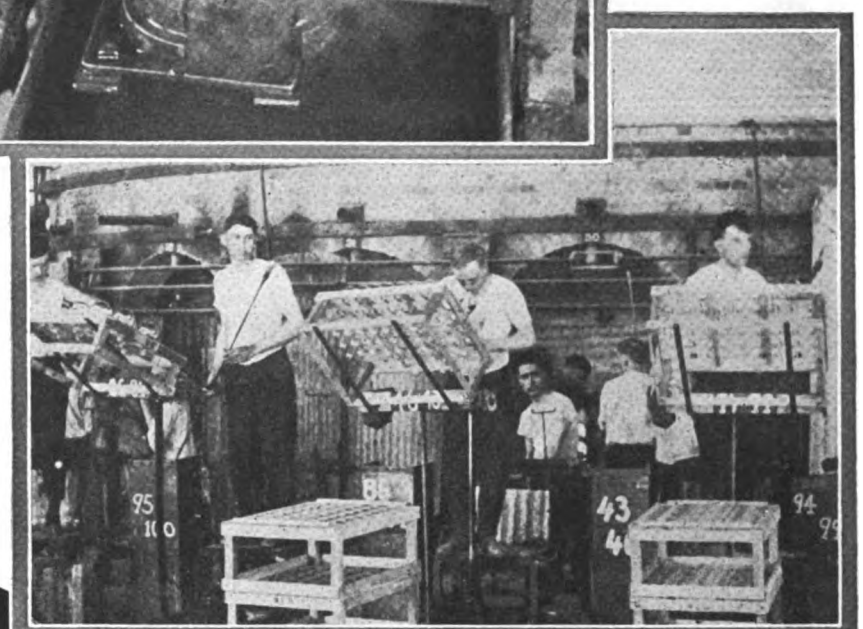
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Blowing bulbs for incandescent lamps. Lamp bulbs are blown like soap bubbles, but the "bubble" is surrounded by a mold to give it the desired shape.

Below—Close-up view of mold in bulb blowing process. The mold is opened and closed by a lever operated by the workman's foot.





General view of blowing room. Each workman has a bulb rack in front of him.

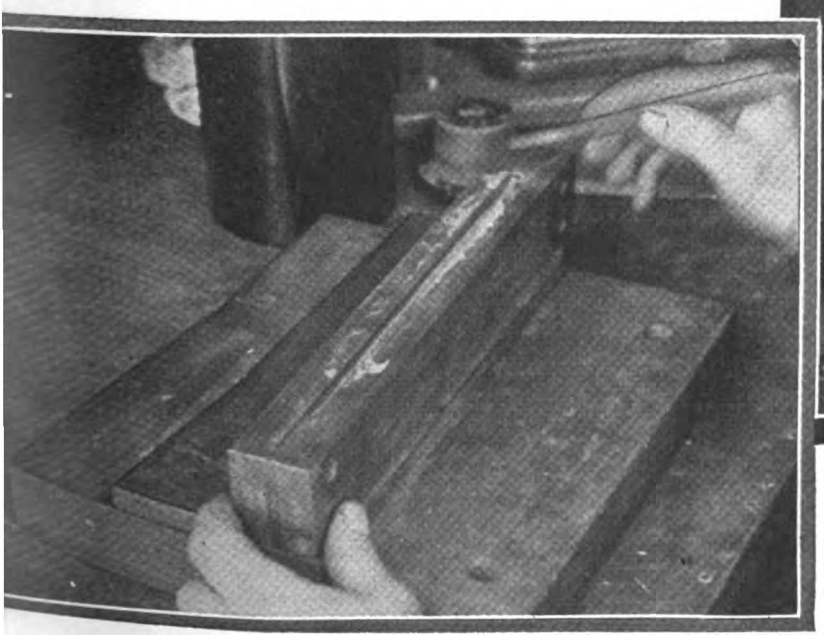
others to produce clear and colorless glass.

These raw materials are carefully weighed, thoroughly mixed, and fused in great clay pots. These pots are made of a special kind of clay and require five weeks to construct. Then, after the pots are completed, several months of "seasoning" are necessary before they are dry enough to use. The pots and their three-fourth ton contents of glass-to-be are kept at a temperature of 2500 degrees Fahrenheit, day in and day out. Worn-out pots are replaced with the furnace operating at full temperature.

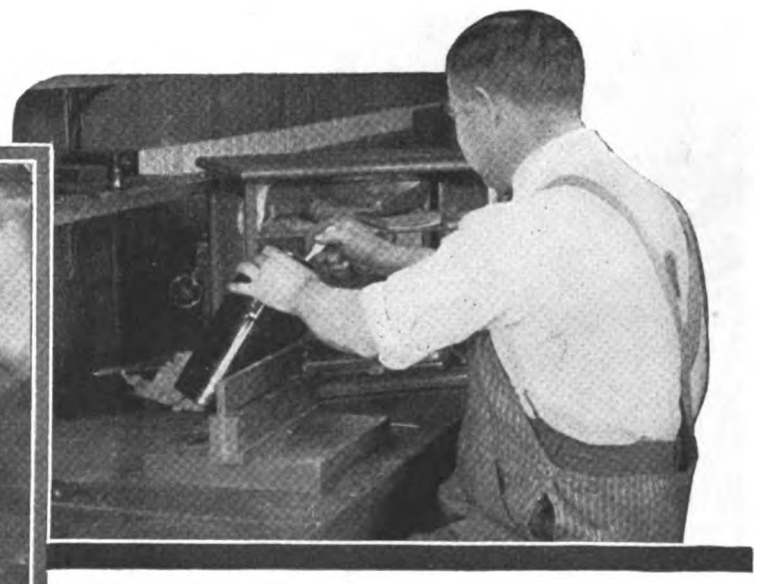
After twenty hours of heating the glass is ready for working. A large ball of molten glass is gathered on a blow pipe and rolled on a "marvering plate" to distribute its mass properly about the end of the pipe. Then it is reheated to make up for the cooling in the previous process, and is pulled into a long hollow tube. Later it is cut into smaller



Inspecting the bulbs for streaks, air bubbles and other flaws.

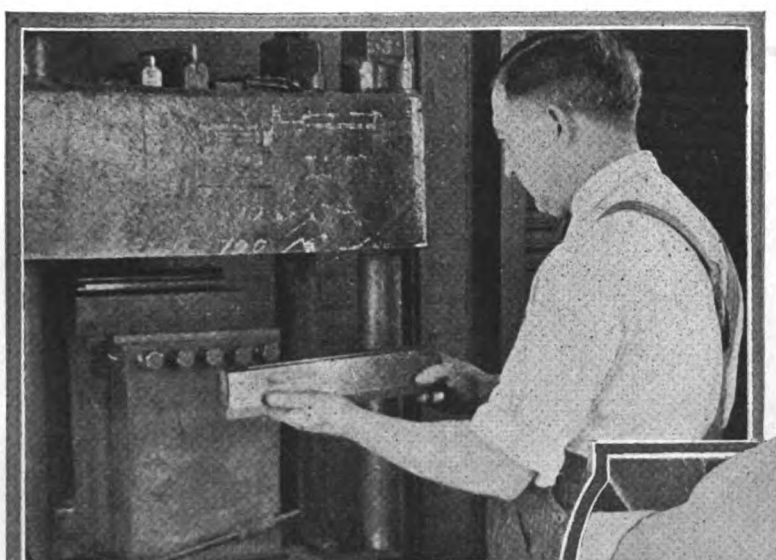


At the left—Placing the powdered tungsten in a grooved mold in which it is subjected to tremendous pressure.

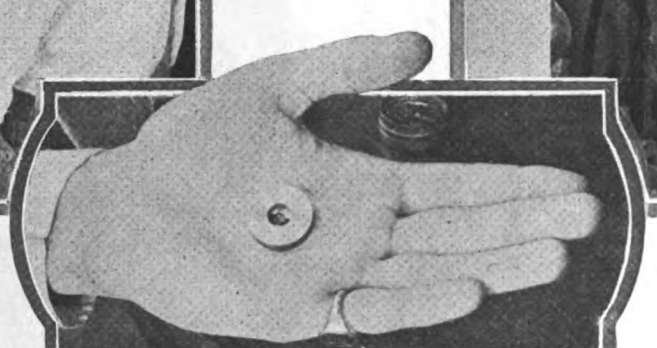


At the left—Accurately weighing powdered tungsten before it is pressed into tungsten ingots—one of the steps in making tungsten lamp filaments.

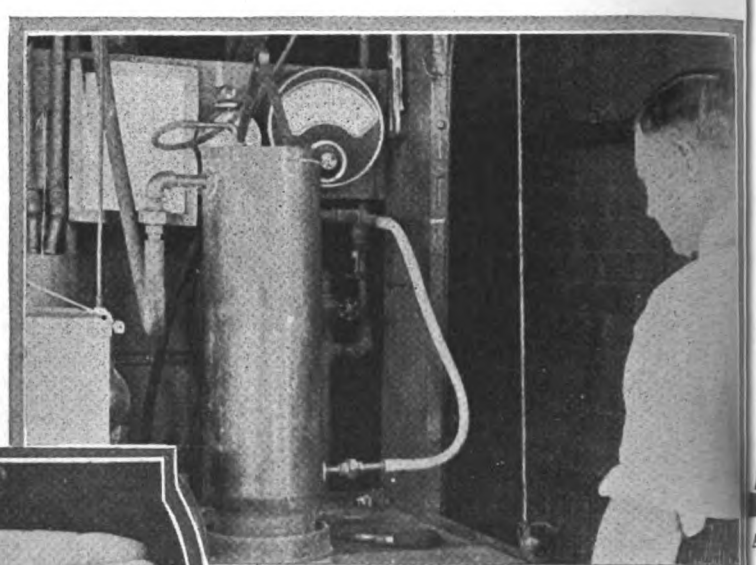
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Placing mold, filled with powdered tungsten, in press.



Die through which the swaged tungsten is drawn to the proper diameter for lamps of various wattages.

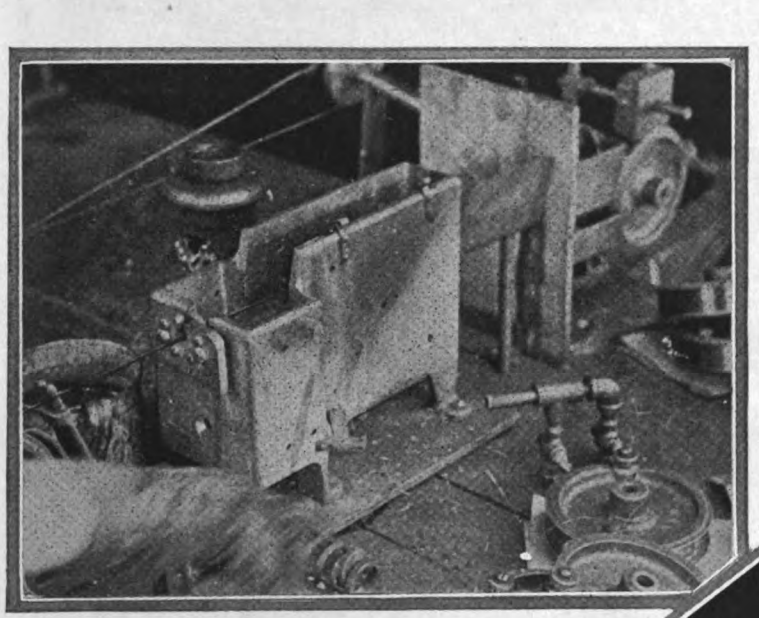


The tungsten ingot is heated in an electric furnace which welds the fine particles together into a solid mass. Later the ingot is placed in a "swaging" machine containing a pair of small hammers which pound the ingot on all sides thus toughening and elongating it.

lengths, inspected for flaws and sent to the lamp factory where it is cut into lamp sizes and flanged at one end to make "flanged tubing." This flange is later fastened to the base of the globe.

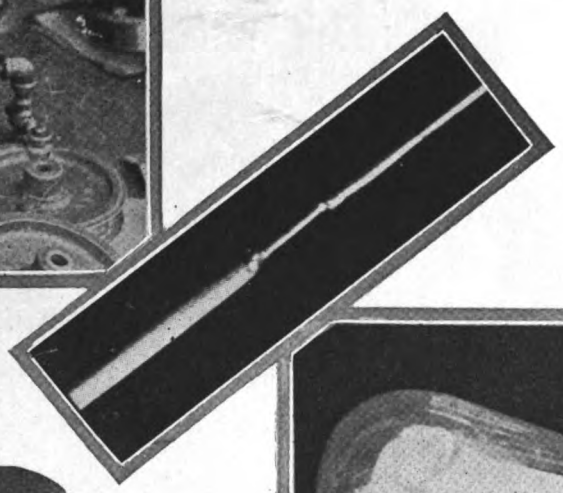
Cane glass, which also enters into lamp making, is drawn into solid rods in somewhat the same way as flanged tubing is made. At the lamp factory this glass is cut into lamp sizes and fused, together with the "lead" wires which carry the current into the lamp, to the unflanged end of the flanged tubing.

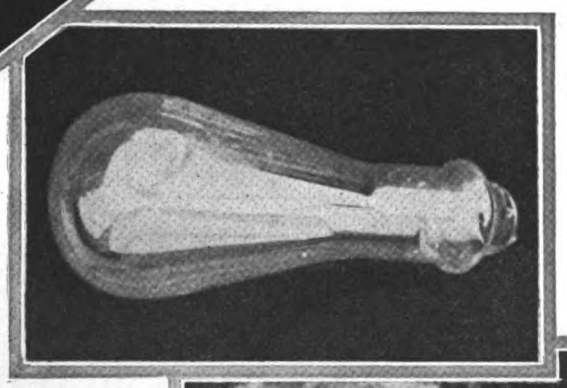
The third lamp part made in



Wire drawing machine fitted with die through which the tungsten wire for lamp filaments is being drawn.

Below—The "lead" wire in an incandescent lamp is of copper and nickel, except for a small portion known as the "press-lead" which passes through the glass and has the same expansion and contraction properties as glass.

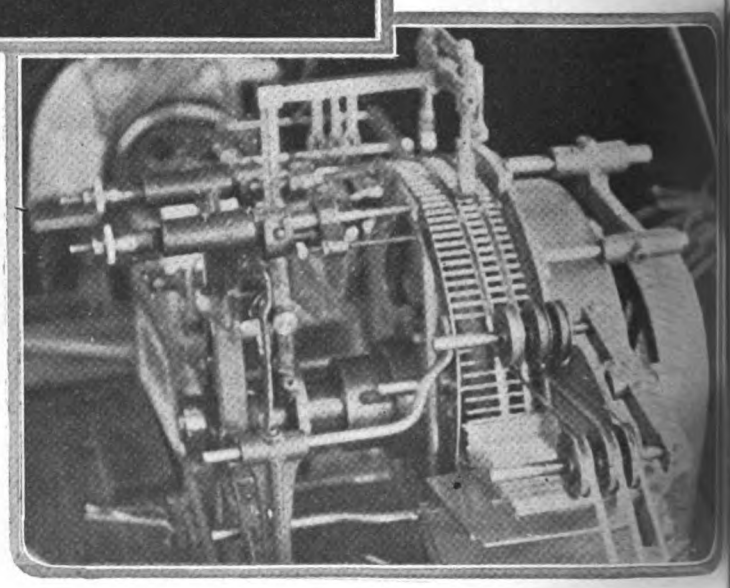




At the left—The bulb as it comes to the lamp factory has some superfluous glass which is left on to facilitate "sealing" and to protect the bulb from cracking.



Cutting tubing for the stem which supports the filament of the lamp.

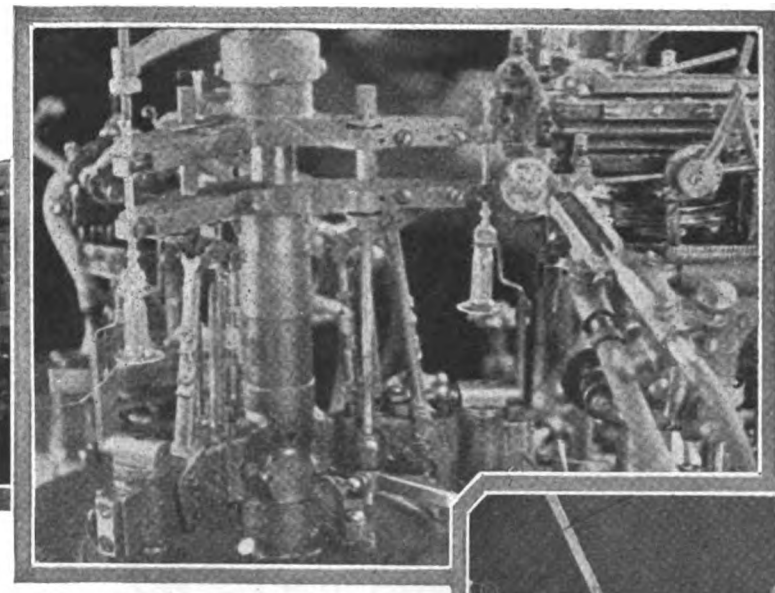


At the right—A "button" machine. The button rod is fastened to the flanged tube.

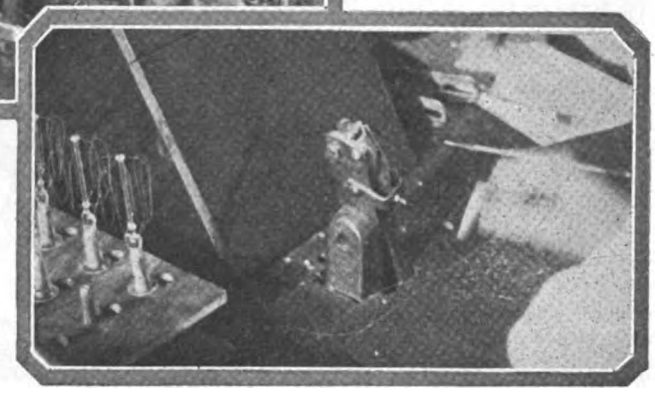
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ssembling stems—flanged tubing, button rod and leading-in wires.



This complex machine puts the filament supports into the button rod.



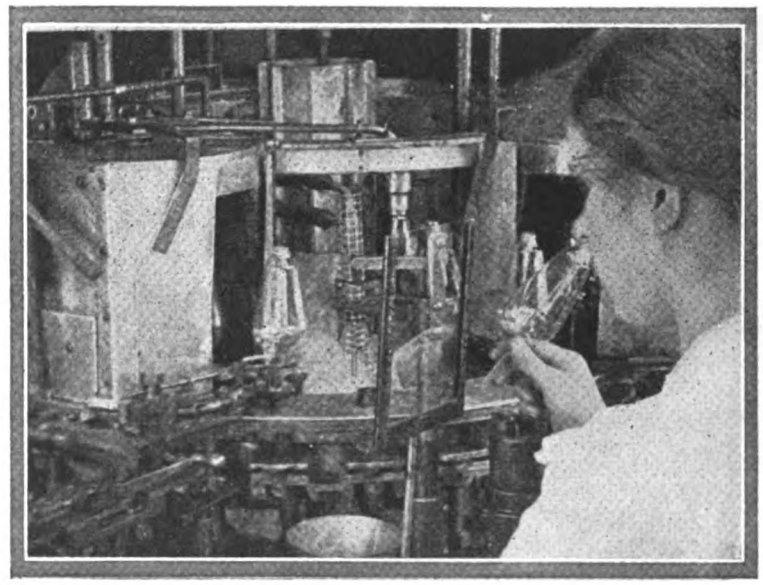
Winding tungsten filaments for vacuum type lamps.

he glass factory is the bulb. amp bulbs are blown like soap ubbles, but the "bubble" is urrounded by a mold to give the desired shape. The mold sprinkled with finely powder- d cork and is moistened, which auses a cushion of steam to e formed between the hot lass and the moist cork lin- ng. Rotating the blow pipe ives the bulb a smooth, pol- shed surface. The blown bulbs re crated and sent to the lamp actory.

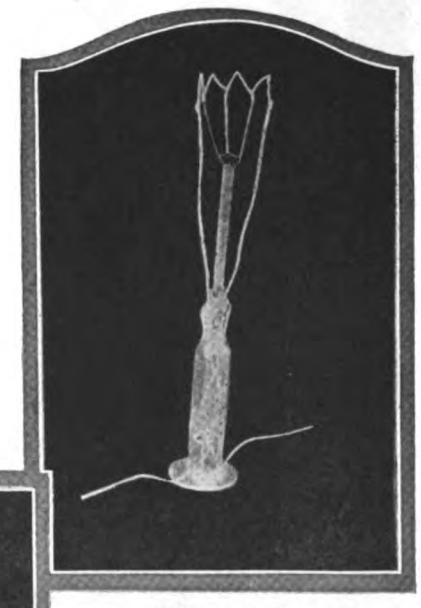
Incandescent lamp filaments re made of tungsten wire hich has been refined from olframite or sheelite ore. The arious impurities are separa- d from the ore and the re- ulting tungsten concentrate is emically treated and fired in ectric furnaces until a pure etallic tungsten powder re- ults.

This powder is placed in olds and pressed into ingots hich have shape, but very ttle strength. The ingots are

(*Continued on Page 32*)

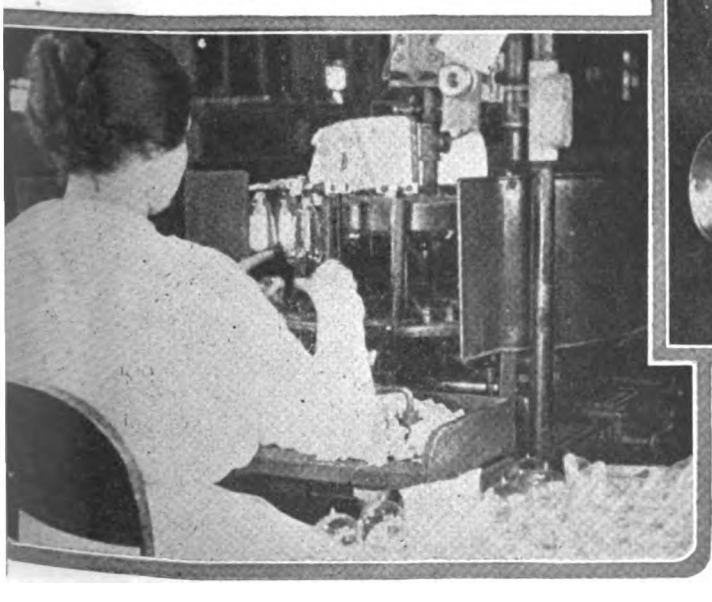


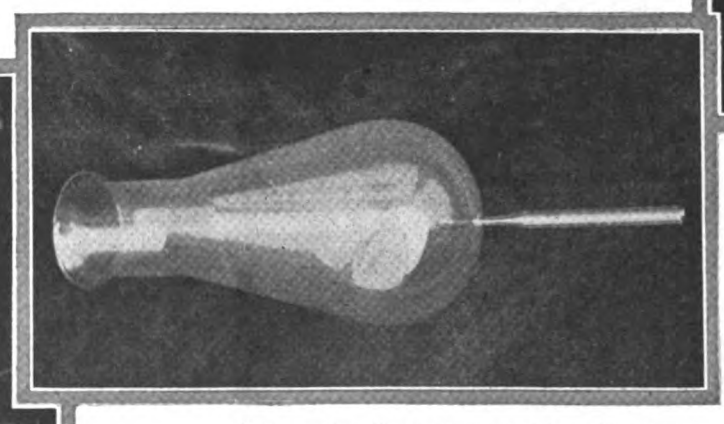
Above—This operation removes air from the lamp, and, in some types, substitutes an inert gas.



Filament mount for gas-filled lamps. Note the lead wires projecting from the flanged tube.

elow—Testing the un-based lamp for echanical defects. A piece of cotton eparates the leading-in wires and prevents a short circuit.





Before the filament mount is placed in the tube, a short piece of tubing, through which the air is removed later, is fused on the end of the bulb. When this tube is sealed off, the familiar lamp tip results.

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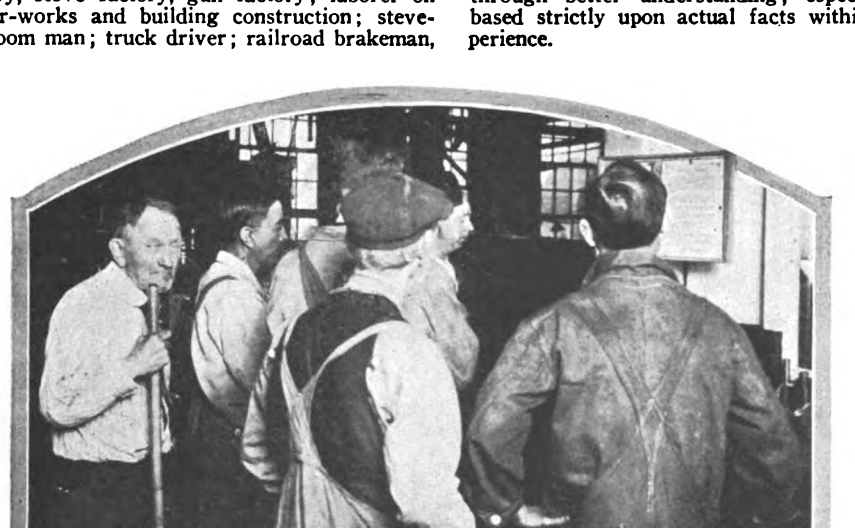
Wages and Wage Cuts

By W. H. Holmes

In view of the interest expressed by many of our readers in a previous article by Mr. Holmes, we take pleasure in presenting the following brief biographical sketch.

W. H. Holmes left school at the age of fifteen and went to work as water-boy on a factory construction job. His 22 years' experience since then includes: bicycle-repairman; factory hand in sheet-metal shop, in oilcloth factory, stove factory, gun factory; laborer on subway, water-works and building construction; stevedore; lunch-room man; truck driver; railroad brakeman, switchman and signalman; machinist, tool-maker, and production hand.

Mr. Holmes is at present employed in a tool room of a manufacturing plant, and considers his writing as an avocation. His experience and viewpoint, coupled with a gift for dramatizing the every-day happenings in the worker's life, make Mr. Holmes' articles of importance to every executive who is interested in better teamwork through better understanding; especially as they are based strictly upon actual facts within the writer's experience.



The notice was scarcely on the board when the workmen were crowding around it.

BEGINNING Monday, Ma 1, a ten per cent redu tion in wages will go into e fect. At present this will onl apply to the production force Present conditions of the trad render the above action nece sary."

The notice was scarcely o the board when the workme were crowding around it.

"Stick by us, Boys, and we' stick you!" snickered a happy go-lucky youth, paraphrasin a war motto. He eyed th expressive faces of his com panions. "Less money, les work," he added, voicing th usual immediate reaction to notice of this type. "Com on, fellows, let's go! We' reduce work twenty per cent!"

Jim Barlow, his mind dis turbed, glanced at the youth "It may be serving them right Lew," he said shortly, "but i ain't paying my bills."

"Serves all of you right!" exclaimed a bystander exul tantly. "You had a chance t get into the Union and wal out with us when we pulled th

Going to the kitchen shelf, his wife took down an account book. She jotted down a number of items, thinking long over each one.





It did not enter his mind that it was only the number of men given employment, which enabled the owner to live.

Jim read what she had marked down: Rent—Coal—



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"Do you expect me to keep house, pay bills, and raise three children on that money; with living what it is?"





"Why, we can't live on that!" said Jim, with a sinking feeling at the realization.



trike. You couldn't see it hen. Now you're getting hat's coming to you. Let's ee you do something for your-elf, now!"

In the meantime, the rest of he force, after talking over ie notice, each taking it ac-ording to his vocal ability and ecessities, most of them earn-stly swearing to look up an-ther job at the first oppor-unity, finally fell into their outine tasks. But vim was acking, and they worked mply as the clock ticked. The ock's hands would eventually each twelve o'clock and re-ase. The tasks were per-rmed with that end in view. One of the men came to Jim's achine. "Jim," he asked, if I put you wise to a good b will you go over there with e?"

"Where?" asked Jim.

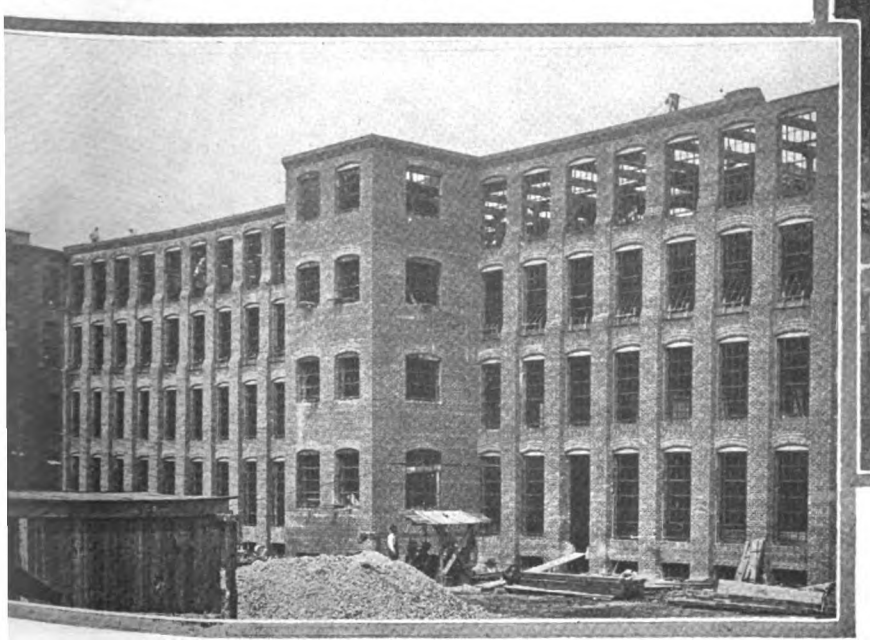
The disgruntled one named

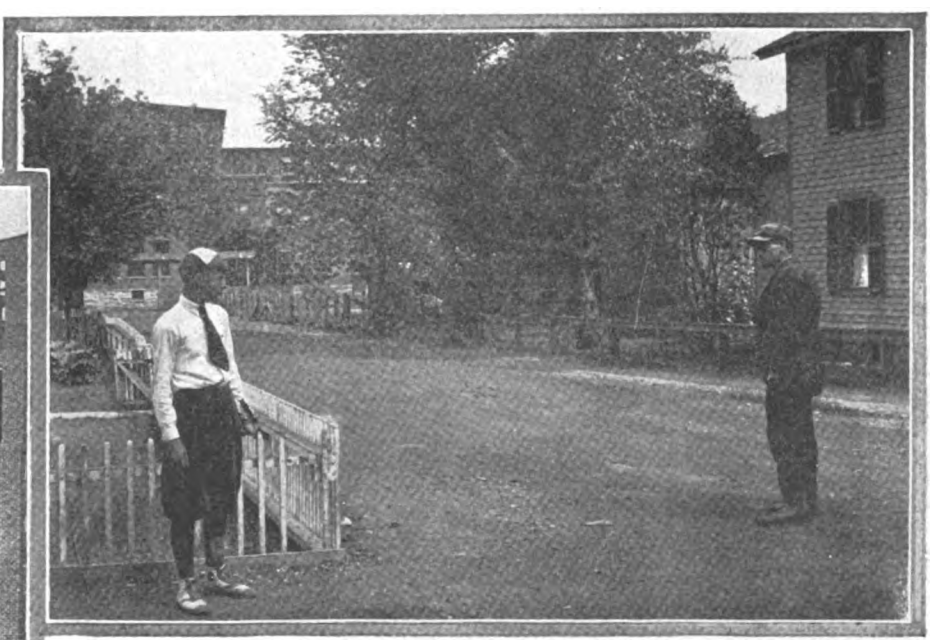


She gave an angry snarl at the children, who were drilling under the direction of the older boy.

'We'll always be living the same way. Nothing to look forward to but debts, poverty and a bare existence."

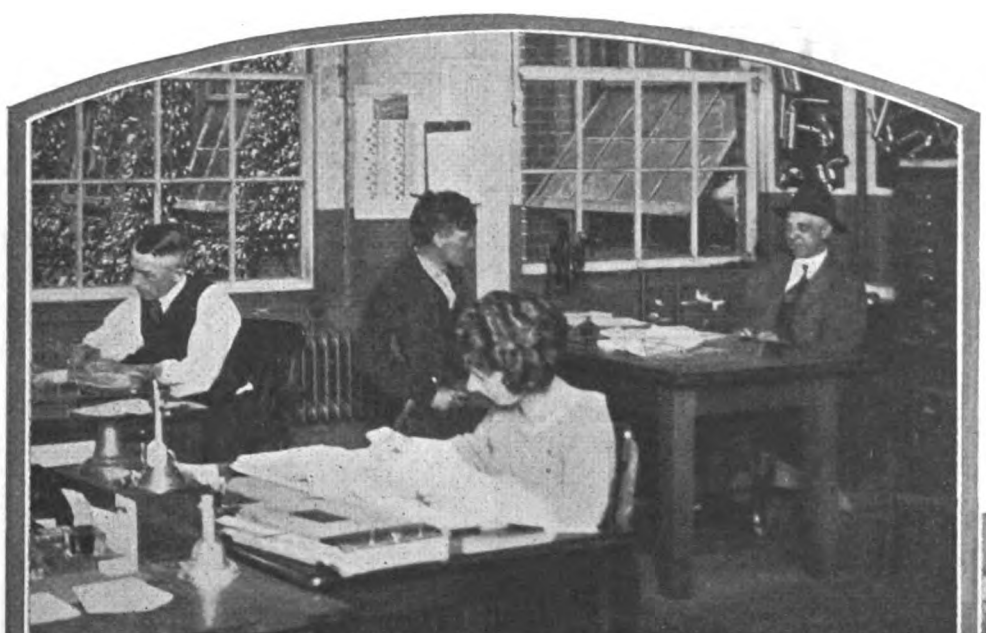
The manufacturer stood by the creation he had built up through the long, lean years.





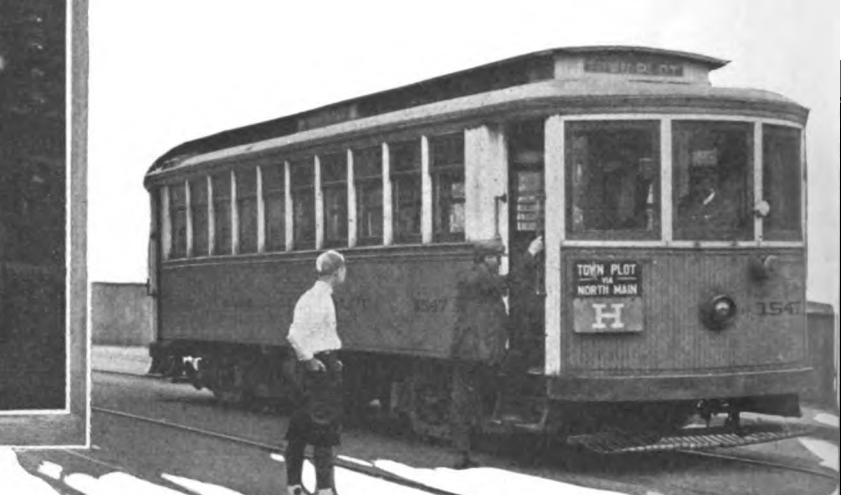
Depressed, Jim left the boy and turned toward the shop.

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Back home was a sullen, discontented wife, unpaid bills, discord and worry. There was nothing for Jim to reason calmy about.

Bob saw his father off on the trolley; but Jim's mind was on his problems.



a shop at the far end of the town.

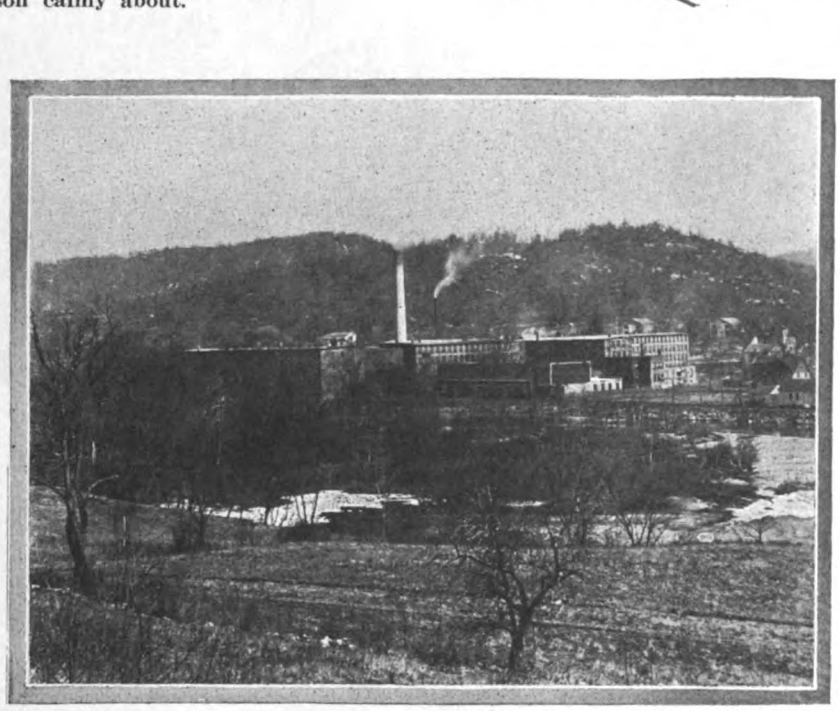
"What's the use," moodily replied Jim. "I get up at six o'clock mornings now. You get up half rested, as it is; hardly enough appetite to drink a cup of coffee and eat an egg. Time you get up five or half-past, pay ten cents car fare each way, and spend an hour or more on the cars, you're tired out. I done that once. You're dead all day."

"What are you going to do," sneered the other; "stay here?"

"I don't know what to do. This place has gone to hell. They don't seem to care whether you stay or get out. All they do is to stick up notices. I never seen one yet in the men's favor!"

"You never will," said the other. "I'm going to get out!"

"It's a hell of a country!"



"Bristol depended, for its prosperity, on the factories and workers first of all."

exclaimed Jim, anxious to pre sent a convincing argument, a the other walked away. "The cut our wages, raise the rents and profiteer all they want and then they go and take away our beer!"

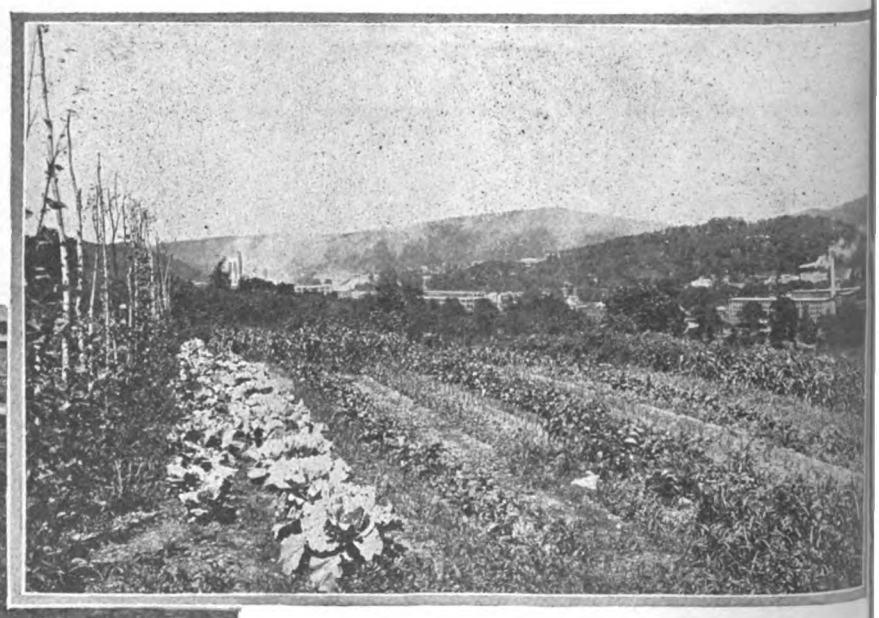
The whistle brought noon and relief. Another worker of socialistic tendencies, walked with Jim toward the shop gates. As they were passing through, they stepped aside to allow the shop owner's car to emerge. It glided past them a large, expensive car, glittering with newness.

"There's your profit system!" exclaimed Jim's companion, seizing the ready illustration. "Our pay is cut; the Boss buys a new car. You and I paid for that!"

(*Continued on Page 36*)

"Many took advantage of the opportunity to get their own homes at reasonable cost.'





"These garden plots meant health, contentment, and a big saving on food."

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The Ever Widening Field of the Typewriter

An Interview with Wellington P. Kidder

AMONG the many epoch-making inventions which have radically influenced human events in general, and industrial progress in particular, what *one* invention stands out as the most far-reaching in its effects? Casting about for an answer to this question, it seemed to the editors that the typewriter, if not *the* leading invention from this standpoint, is at least one of the leaders. So we decided to ask Mr. Wellington P. Kidder what he thought about it.

Mr. Kidder possesses a very unique distinction—he is the father of a truly quiet and well-behaved child, the Noiseless Typewriter. Although he modestly assigns a large part of the credit to associate engineers, Mr. Kidder is the original inventor of the principle of pressure printing by leverage, as distinguished from the hammer-blow principle.

"I believe it true," said Mr. Kidder, "that few inventions of our time have stimulated more of effort and achievement in every field of research than typewriting machines—hand maidens of the printing presses—'poems in mechanism.'

"To write at all, by machinery, even upside down or invisibly, was, at the outset, a great achievement. All credit to Showles of Milwaukee, no farther back than about 1872, for the practical initial step.

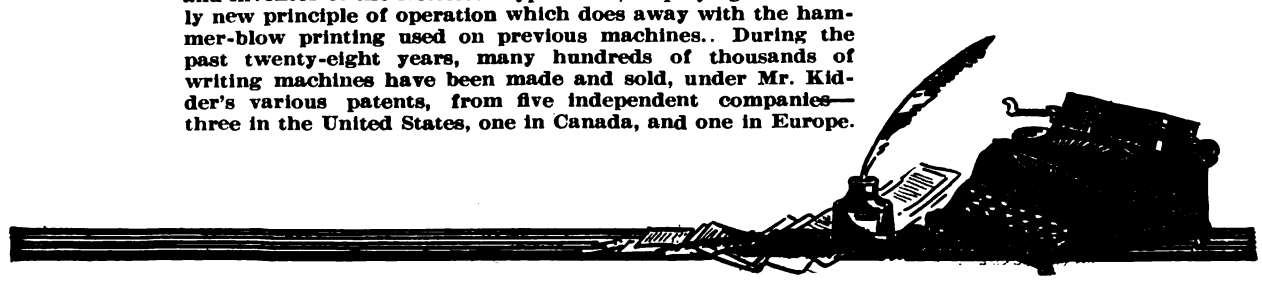
"The thought did not meet with favor at first. Recipients of typewritten letters—up hill and down dale as to alignment, and in capitals only—sometimes took offense, saying, 'you need not *print* words for us, we can read writing.' Others were amused and recommended *skilled* printers to set their type if this sort of correspondence was to be used.

"Soon it became evident that typewriting easily could be three or four times as rapid as hand writing and far more legible, with capacity for sev-

(Continued on Page 34)



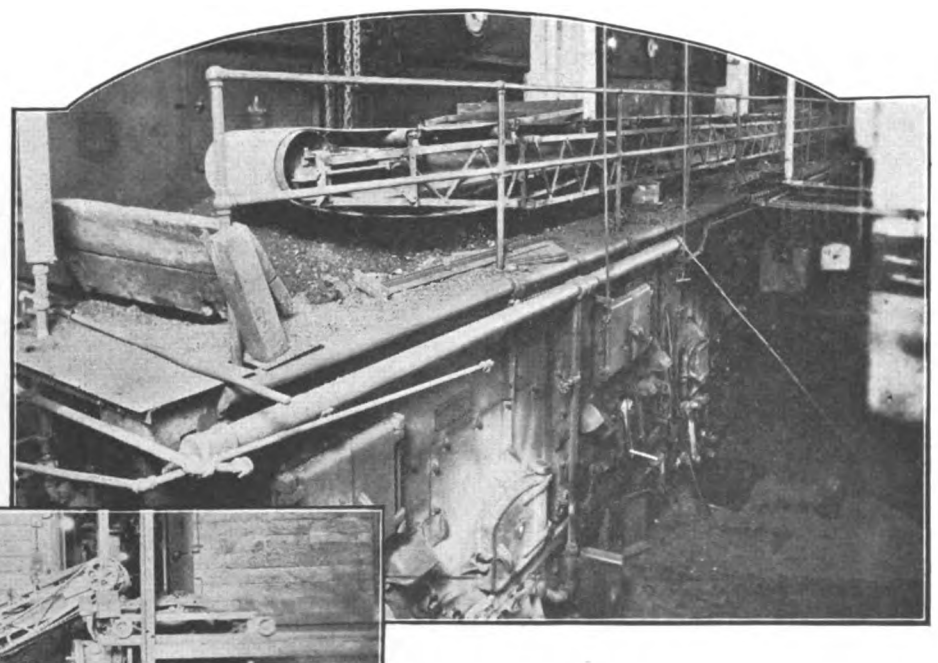
Wellington P. Kidder is best known as the original designer and inventor of the Noiseless Typewriter, employing a radically new principle of operation which does away with the hammer-blow printing used on previous machines.. During the past twenty-eight years, many hundreds of thousands of writing machines have been made and sold, under Mr. Kidder's various patents, from five independent companies—three in the United States, one in Canada, and one in Europe.



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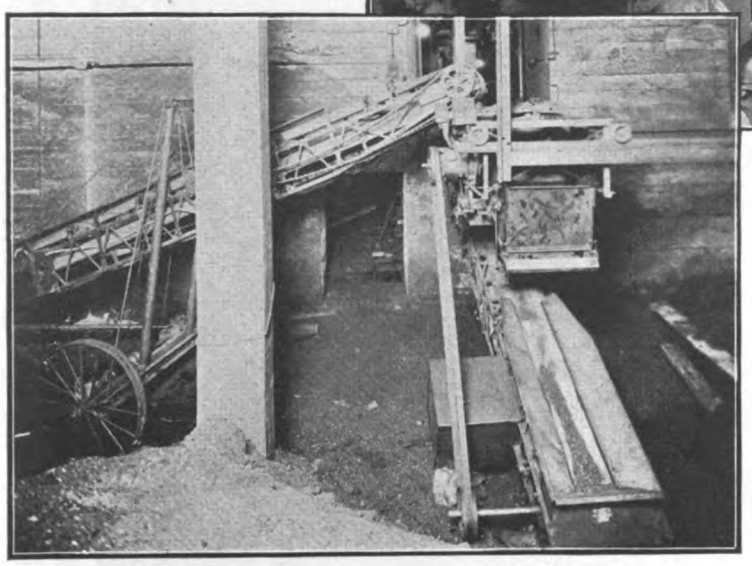
Coal Buying and Burning for Industrial Power

BY BROWNING ROBINSON



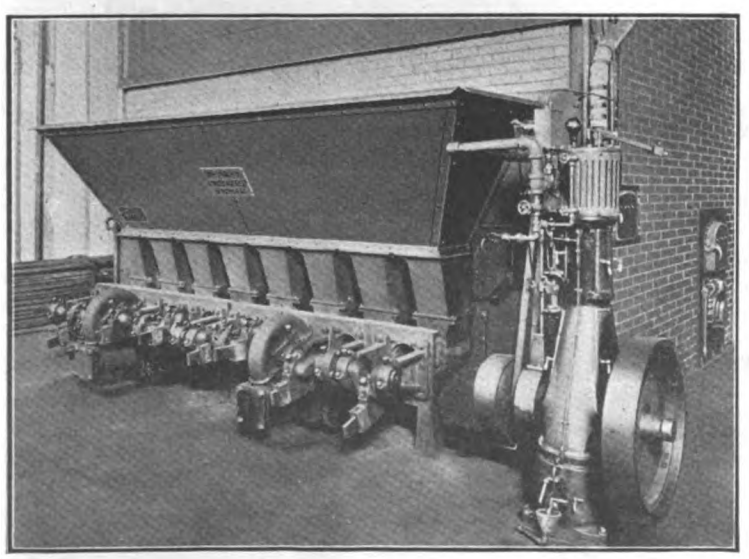
At the Montefiore Home and Hospital, New York, a conveyor is fitted with sweeps which brush the coal off at the desired point above the stoker.

Barber-Greene Co., Aurora, Ill.



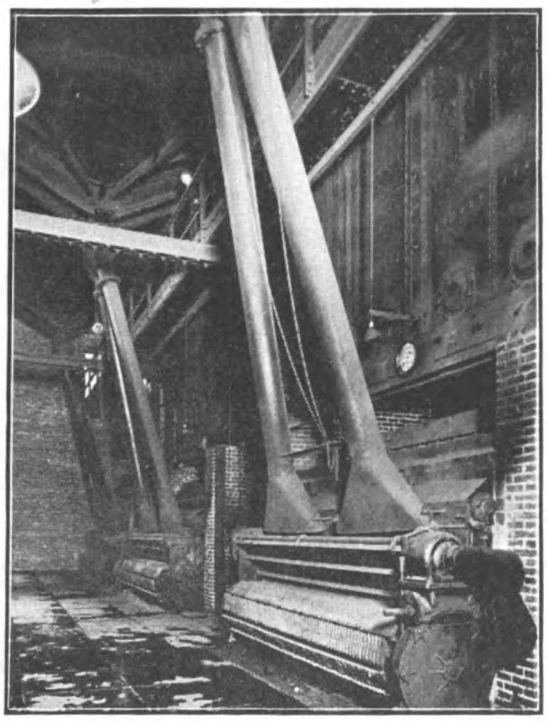
Feeding the conveyor shown above is the portable conveyor shown here which takes coal from the storage pocket and places it on the long conveyor shown at the right. In so doing all of the coal passes through the automatic weighing machine shown above. With this outfit one shoveler on the day shift and the night engineer in his spare time do the work formerly done by seven men.

Barber-Greene Co., Aurora, Ill.



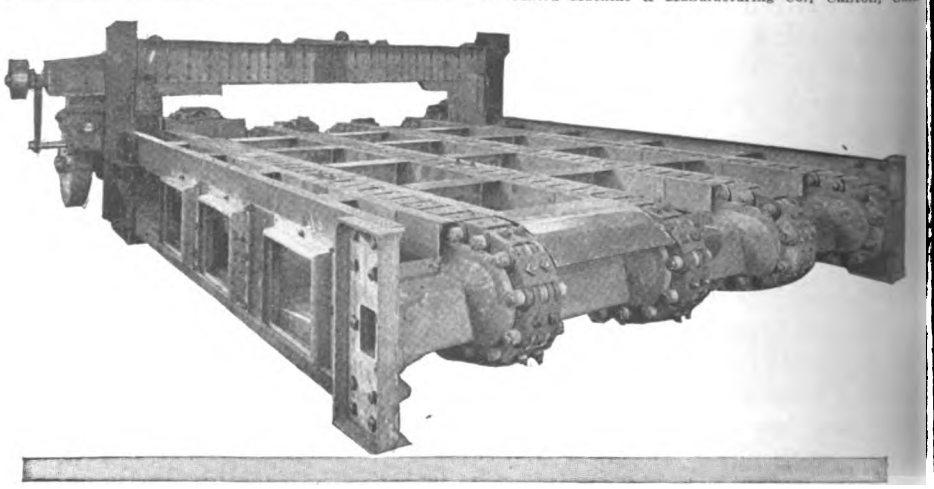
The mechanical stoker represents a great forward step in power plant engineering. In addition to largely eliminating labor costs, it increases the capacity and flexibility of operation of steam boilers. This multiple retort stoker at the plant of the Burroughs Adding Machine Co., has brought fires from a banked condition to 340% rating in five minutes.

Detroit Stoker Co., Detroit, Mich.



Mechanical stokers since they remove the element of skill from the firing problem enable the cheaper grades of fuel to be economically and efficiently burned. Here are shown three 720-horsepower boilers at the plant of the Chicago By-Products Coke Co., using Illinois slack coal and coke breeze as fuel.

United Machine & Manufacturing Co., Canton, Ohio.



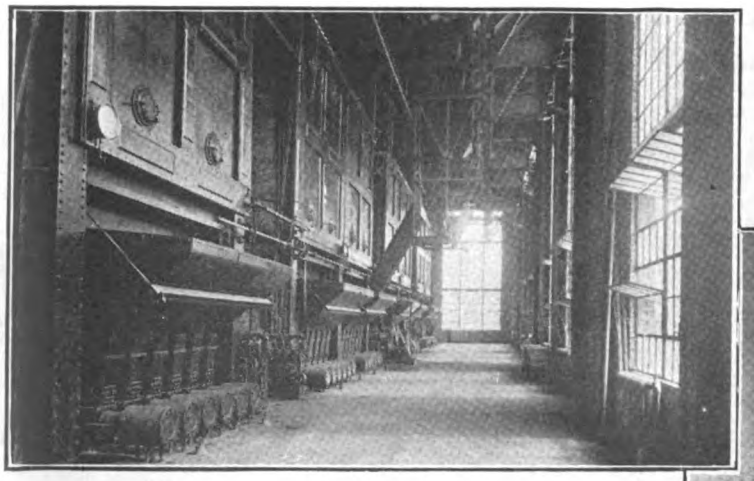
Here is a semi-assembled rear view of the stoker shown above, depicting the cross girder and return tracks.

United Machine & Manufacturing Co., Canton, Ohio.

THE original American development of boilers, furnaces and stokers naturally occurred in the settled areas of the north eastern states. When eastern men engaged in the industrial migration to the central west they brought into western use the equipment with which they were familiar. In those days local fuel and labor were inexpensive, and waste little thought of. Coal analysis and differences in fuels were inconsequential. Smoky stacks, both in fact and poetry, were considered a sign of prosperity. Today we realize that only great profits could possibly have carried such a burden.

As communities turned attention increasingly to better living conditions, and plant executives began to scan cost sheets more closely, it was

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Above is the boiler room of the Cadillac Motor Car Co. of Detroit. Modern plants spare no expense in installing equipment that will ultimately effect the greatest economy and pay the greatest dividends. Note the battery of seven 603-horsepower boilers, equipped with stokers.

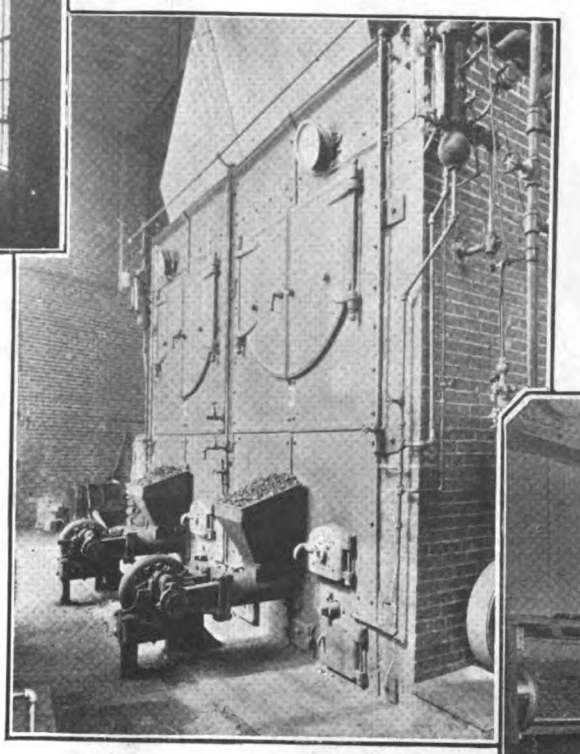
Under-Feed Stoker Co. of America, Detroit, Mich.

learned that much smoke, nuisance and waste were due to incorrect methods of handling fuels.

About that time was begun the primary study of differences in coals, rules for operating fuel-burning apparatus, and the investigation of grates, furnaces, and the correct burning of local fuels, all better adapted to the new conditions.

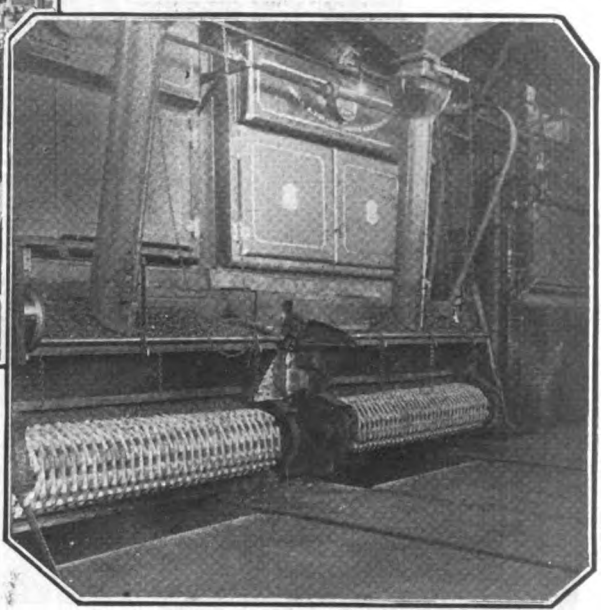
It must be thoroughly understood that there is even today no single equipment which will properly and economically handle all varieties of American coals.

Owing to the generally increasing sizes of power plants, hand firing is now less com-



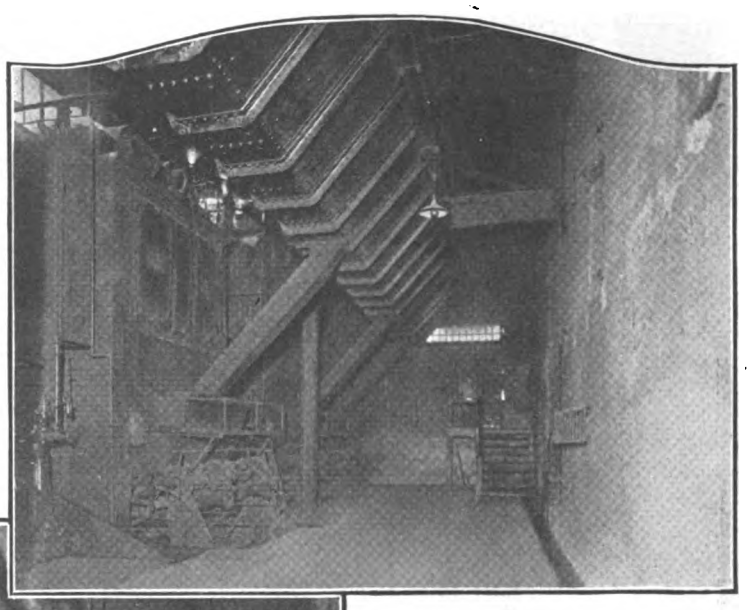
Stokers are usually thought of in connection with large boiler units. This picture is notable in that it shows two 150-horsepower return tubular boilers at the General Aluminum & Brass Mfg. Co.'s plant at Detroit that are stoker-equipped. The investment is said to pay large yearly dividends.

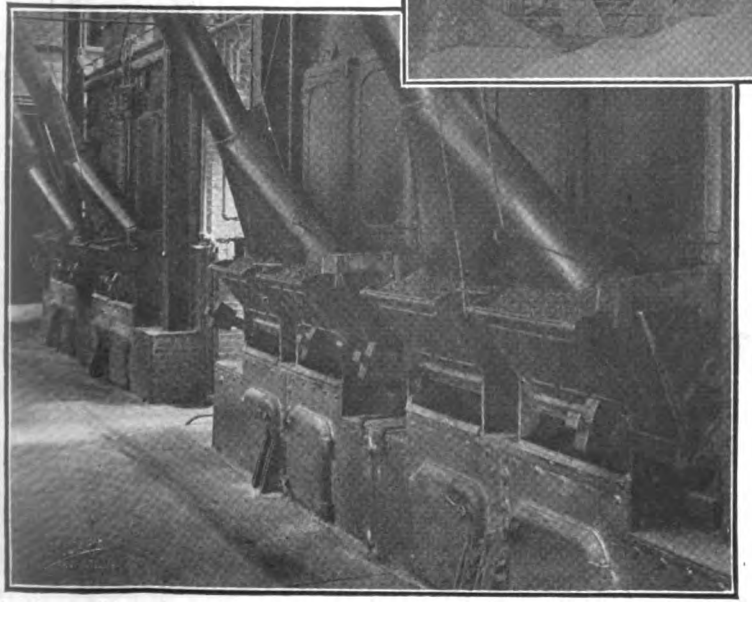
Detroit Stoker Co., Detroit, Mich.



In the plant of one of the large paper corporations shown above they formerly had eight boilers tended by eleven firemen. Since the installation of mechanical stokers five boilers, two firemen and a water tender are required, and this is not all of the saving represented for the steam production has been largely increased even with decreased number of boilers.

American Engineering Co., Philadelphia, Pa.



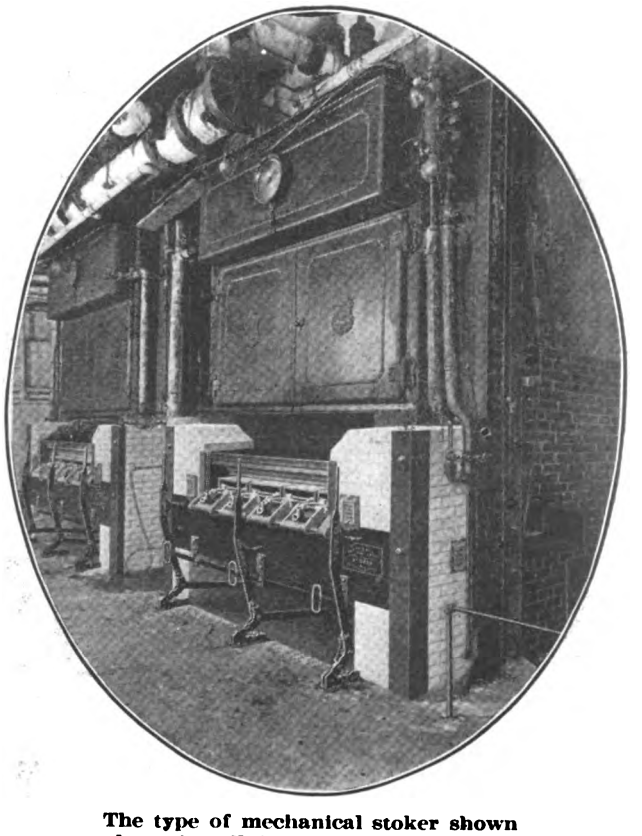


The installation of these four stokers under the 200 H. P. boilers of the Scranton Button Co., of Scranton, Pa., are reported to have saved nearly 6000 tons of coal per year.

McClave-Brooks Co., Scranton, Pa.

An installation of stokers at the Bell & Zoller Mining Co., Ziegler, Ill. There is an almost complete absence of dirt in connection with the operation of such equipment.

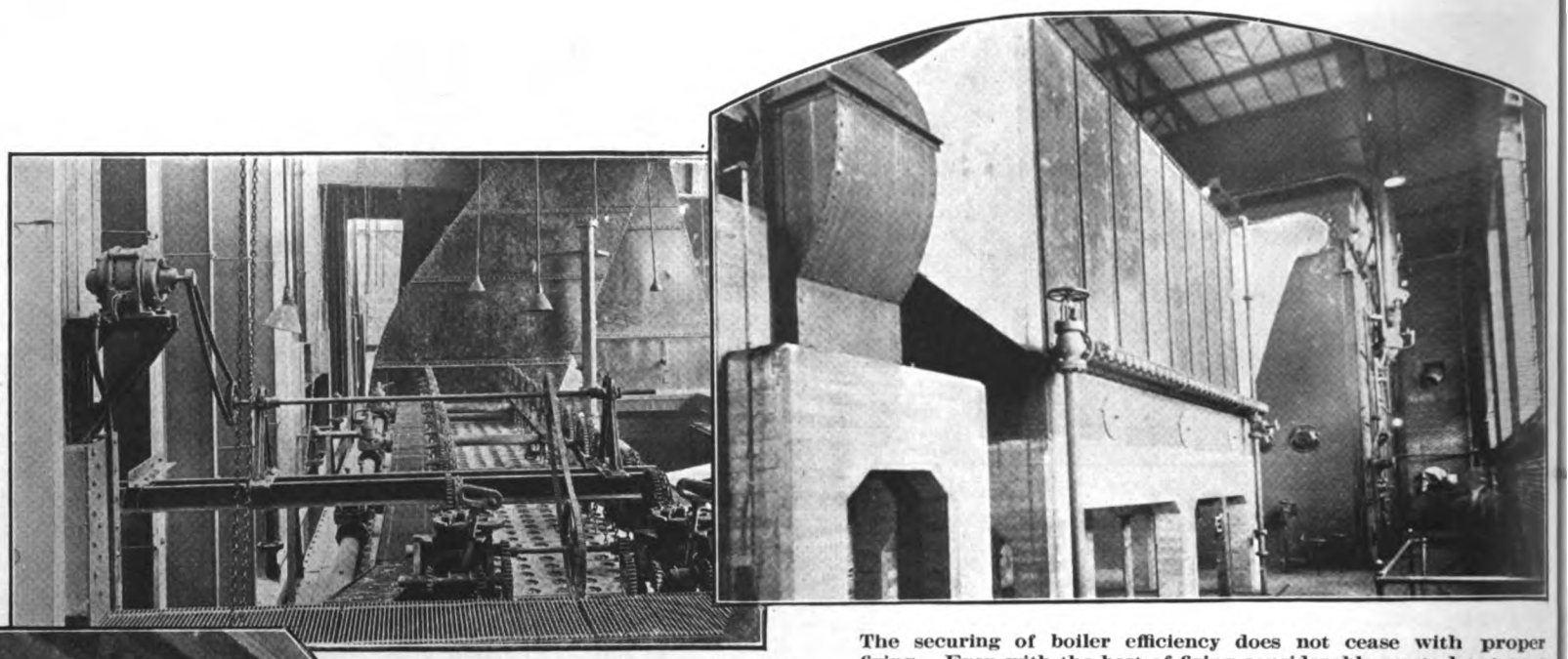
Green Engineering Co., East Chicago, Ind.



The type of mechanical stoker shown above, installed at the Douglas County Court House, Nebraska, is called a low hopper feed installation because it can be put under a low set boiler.

CoKal Stoker Corp., Chicago, Ill.

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To maintain maximum efficiency in heat transfer economizer tubes must be kept clean. The apparatus shown above is equipped with a scraper operating mechanism that is constantly at work cleaning the tubes and thus maintaining a high operating efficiency of the economizer.

Green Fuel Economizer Co., Beacon, N. Y.

The securing of boiler efficiency does not cease with proper firing. Even with the best of firing considerable waste heat goes up the stack. Modern engineering genius has met this condition by devising fuel economizers, which make use of the last usable heat unit. Here is a unit installation of boiler economizer and induced draft fans arranged for easy access.

Green Fuel Economizer Co., Beacon, N. Y.



It is necessary to have the interior surface of hand holes scraped clean as well as clean flues. This picture shows a device for scraping the interior of hand hole openings.

The Roto Co., Hartford, Conn.



This shows a type of rotary scaler driven by compressed air, steam or water, and applicable to either water tube or fire tube boilers. Passing this appliance through the boiler tube removes the scale.

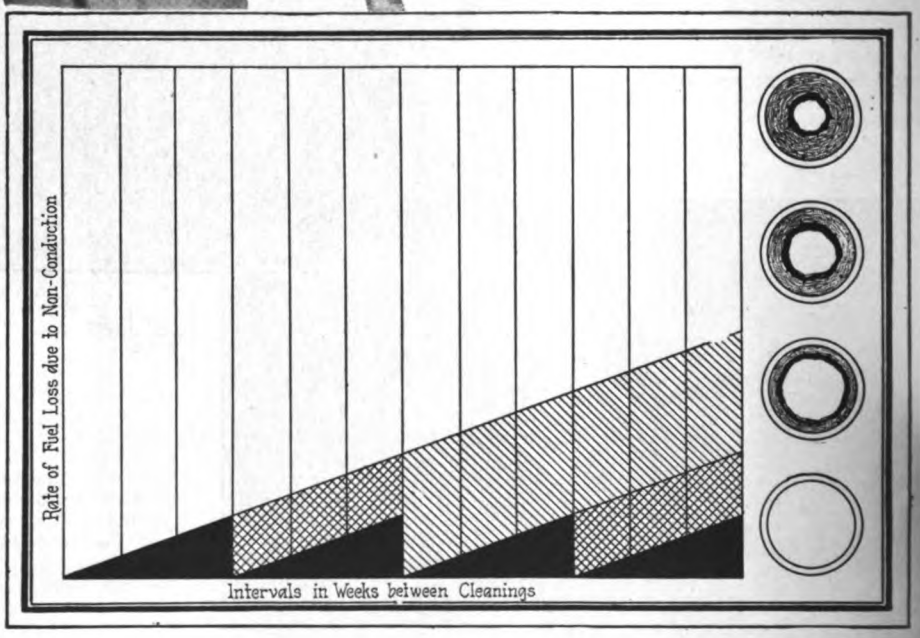
The Roto Co., Hartford, Conn.

monly considered. Some one of the many kinds of mechanical stokers is most apt to be installed in a new plant today, and if the plant is large there can be no consideration of having it fired by hand. With the planning of a large and modern steam plant skilled engineering talent is more apt to be focussed on the subject of selecting proper equipment and methods than was thought to be reasonable even a few years ago. We are, however, equally concerned with the problems of plants already erected and operating, whose conditions and equipment may be improved—with knowledge.

This device is a machine designed for cleaning B & W caps. Its capacity is from 100 to 150 caps per hour.

The Roto Co., Hartford, Conn.

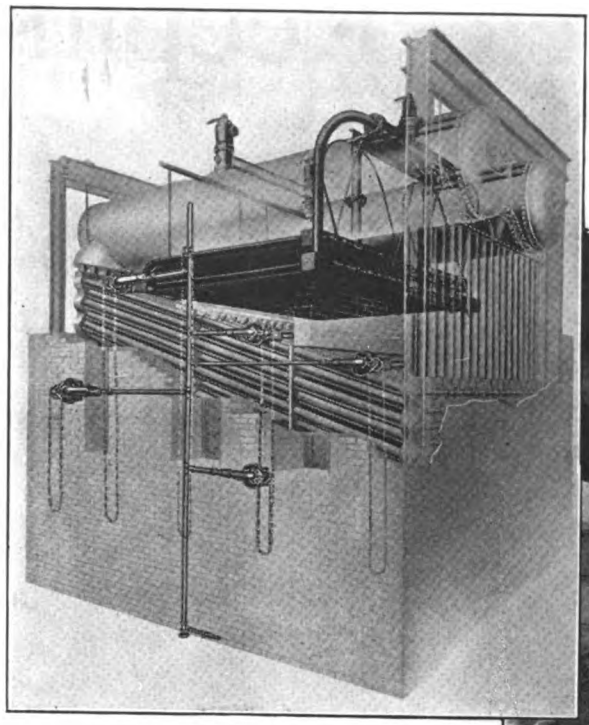




The importance of periodic cleaning is illustrated by this chart. The horizontal scale represents the intervals in weeks between cleanings, while the vertical scale indicates fuel waste due to loss of conductivity. Thus if average boiler tubes are cleaned every three weeks the fuel loss will be as represented in black. If they are cleaned every six weeks the cross-hatched areas represent the loss, and if every twelve weeks the fuel loss is represented by the total area.

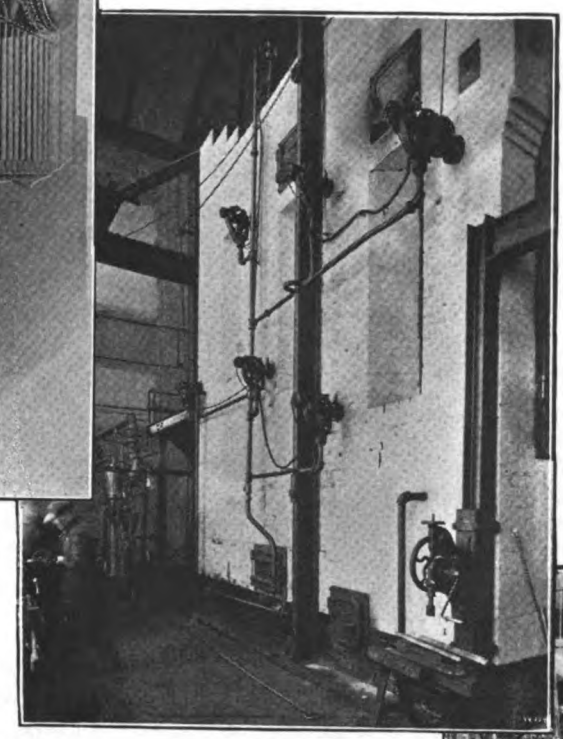
The Roto Co., Hartford, Conn.

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Soot, which continually forms on the surface of water tube boilers, is an effective insulating material. As a result the efficiency of a boiler containing an accumulation of soot decreases. Here is a device for blowing the soot off of such tubes at certain intervals.

ond Power Specialty Co., Detroit, Mich.



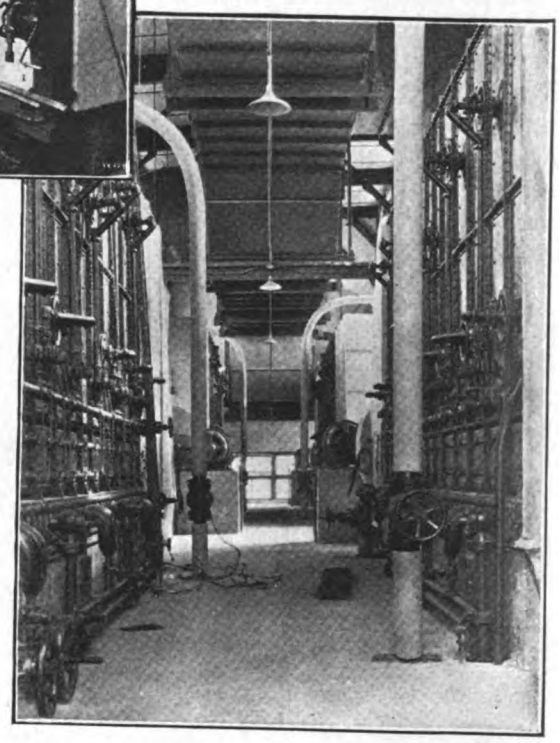
This illustration shows an entirely new phase of soot blowing. The operation in this case is automatic being effected either by means of a clock controlled electric motor or a timing device connected with the mechanical stoker engine.

Diamond Power Special Co., Detroit, Mich.

All coals consist of moisture, olatiles, carbon, and ash or sidue which is unburnable. he heating value depends actically upon the per cent carbon and the characterics of the ash. Ash may disrb or interfere with the exaction of heat units. Otherise it is unimportant except r the cost of handling.

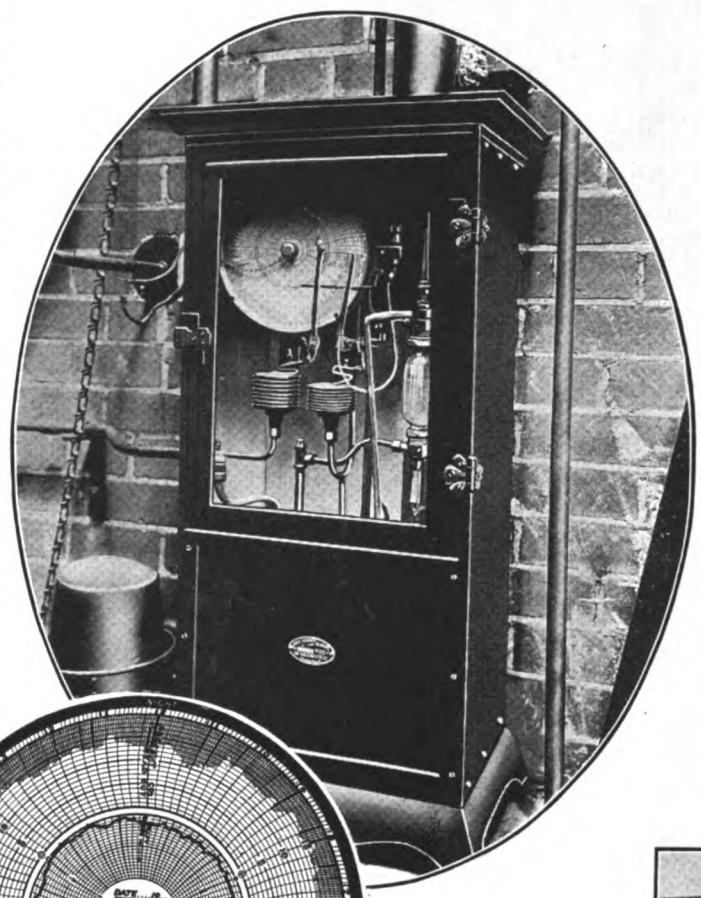
One pound of pure carbon ntains 14,544 British thermal its (BTU). The heating lue of coal depends upon the

(*Continued on Page 48*)



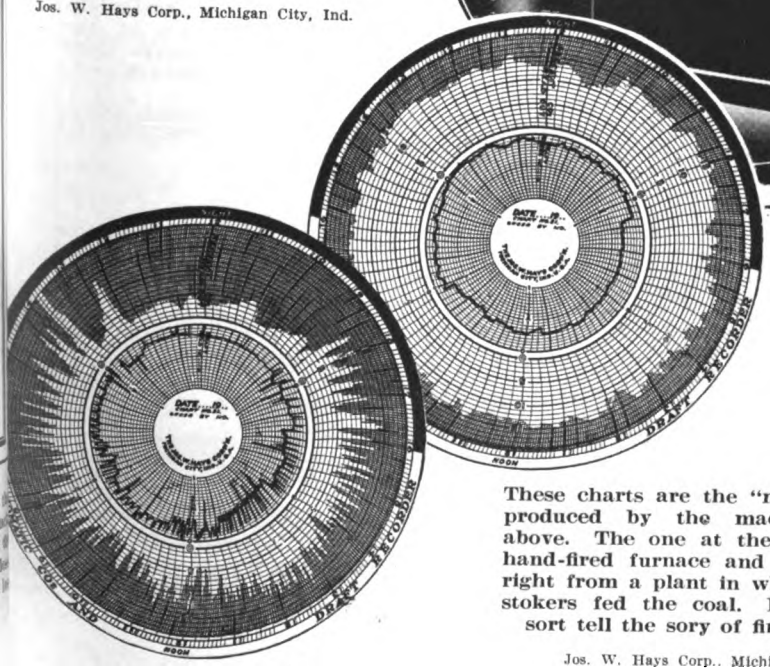
Soot gathers upon conomizer tubes as well as upon boiler tubes. Here is an installation of soot blowers on economizers which not only blow the tubes but also prevent soot from accumulating at the bottom of the economizers.

Diamond Power Special Co., Detroit, Mich.



Here is a machine which makes "moving pictures" of boiler performance. It works automatically, a small string of water furnishing the power, the operator merely putting in a new chart every day. It makes periodic consecutive records of draft over the fire and the percentage of CO_2 in flue gases. When you have this record in addition to the amount of coal and feed water evaporator per hour, you know about all there is to know about how your boiler is being operated.

Jos. W. Hays Corp., Michigan City, Ind.

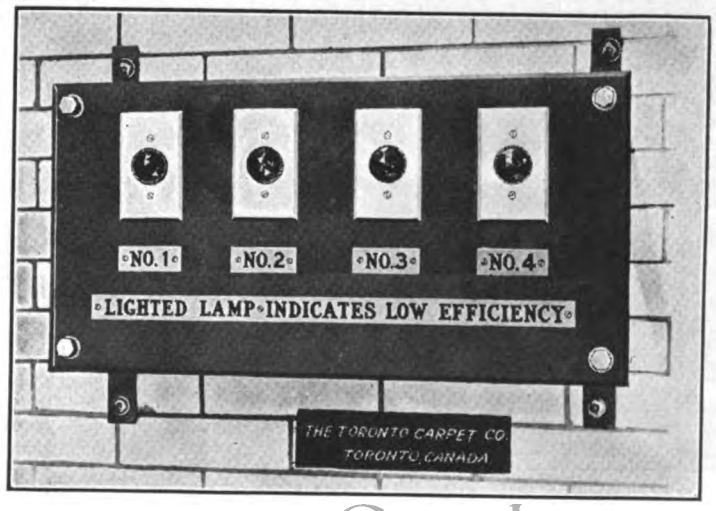


These charts are the "moving pictures" produced by the machine described above. The one at the left is from a hand-fired furnace and the one at the right from a plant in which mechanical stokers fed the coal. Pictures of this sort tell the sory of firing efficiency.

Jos. W. Hays Corp., Michigan City, Ind.

Above the chief engineer's desk at the Toronto Carpet Co., Toronto, Can., is an efficiency board which tells him how the coal is being burned.. When the CO_2 falls below the eight per cent. in any one of the four furnaces a red light calls the fact to his intention.

Jos. W. Hays Corp., Michigan City, Ind.



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Modern Stock Keeping

By R. M. Nicholson

THERE are five fundamental essentials to economical and efficient stock keeping.

1. Preservation of stock
2. Elimination of loss
3. Ease of handling
4. Economy of space
5. Adaptability

Of course, the human factor is primarily responsible for the results obtained and this factor always will be variable. But any equipment, plan or system which makes it easier to avoid error, delay or loss is an encouragement to human effort. It gives man a chance to approach perfection.

Wooden bins and shelves, so common a few years ago, are now rapidly passing into the discard as a better and more efficient equipment has been developed and put into use generally by the more progressive concerns. This is the steel bins and shelving assembly.

Steel does not soak up oil, creating fire hazard. It cannot burn and offers no food for flames should a fire start in the plant. The advantage of this fire-resisting quality is emphasized by the two photographs at the bottom of this page, both taken in the building of the Sharon Hardware Company, Sharon, Pa., after a disastrous fire.

Aside from the graphic lesson on fire-resistance, the illustrations on this page give an idea of the capacity, versatility and convenience of steel; qualities which have been responsible for the rapid adoption of this kind of equipment in recent years.



Rack type of shelving used by the Johnston Harvester Company, Batavia, N. Y., for storing patterns. The individual shelves are 40 inches deep, by 60 inches long, with a capacity of 250 pounds.



The above illustration gives a comprehensive idea of the flexibility obtainable by combining various unit sections according to the individual requirements.

Thousands of pounds of stock parts stored in compact, accessible fashion, at the Albany Garage Company, Albany, N. Y.

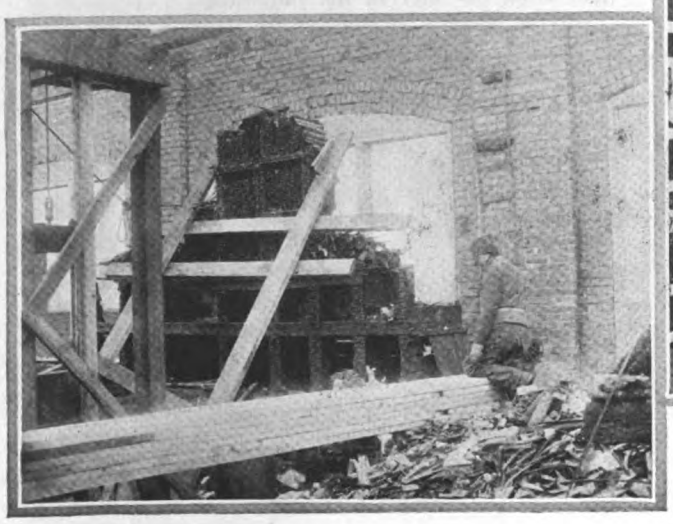
Drills, taps and mandrels, as stored at the Johnson Bronze Company's plant, New Castle, Pa. Inclined trays make for "high visibility."

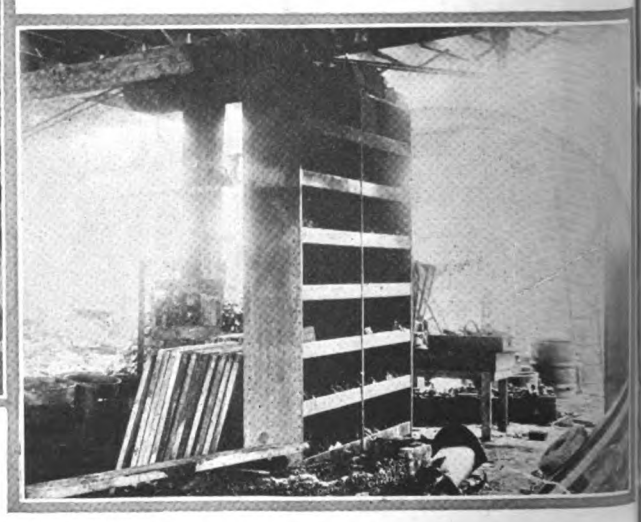
Below—At the plant of the Sharon Hardware Company, Sharon, Pa., wooden stock bins burned and scattered their contents when a disastrous fire swept the plant.



This ten-foot-high storage assembly is in use by the Westinghouse Electric & Manufacturing Company at South Philadelphia. Need of additional storage space was met by putting rows of extra units on top of the original ones.

Below—A section of steel stock bins which went through the fire at the Sharon plant without damage to itself or to the parts it contained.





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The Future of Electrical Engineering

By Benjamin F. Bailey, Ph. D.

THE role of the prophet is dangerous. We can always see a little way down the river, but it is impossible to see what lies beyond the bend. It may be worth while, however, to consider some of the developments that are more or less within sight and to hazard a guess at some of those that cannot be so clearly seen.

One of the phases of electrical engineering that has assumed importance within the last few years and which will apparently be of increasing importance as time goes on is vacuum tube engineering. The vacuum tube only a few years ago was a laboratory toy; something for a college professor to play with when he had no better use for his time. Today it is not too much to say that it is one of the greatest factors influencing our civilization. The recent improvements in long distance telephony would have been impossible without its use. Radio communication, as we know it, especially telephonic communication by radio, is absolutely dependent upon the use of the vacuum tube. The marvelous results obtained in wireless telephony, particularly telephony between airplanes and stations on the ground, would have been impossible without it. We can send a telephonic current so faint as to be indistinguishable by ordinary means and by the use of a vacuum tube amplify it so as to make telephonic communication over thousands of miles practicable. The loud speaking telephone is an illustration of its use. Loud speaking telephones have actually been produced capable of giving such a volume of tone that a conversation can be heard a mile or more away. New developments are being produced so rapidly in this field that it is difficult to keep up with them and I should hesitate to predict what may happen in the near future.



Benjamin Franklin Bailey graduated from the University of Michigan as an Electrical Engineer in 1898, and received the degree of Doctor of Philosophy in 1907. After a varied experience with the Detroit Edison Company and the General Electric Company, he became an instructor and later (1913) Professor of Electrical Engineering at his Alma Mater—which position he now holds. Doctor Bailey is Consulting Engineer of the Fairbanks-Morse Electric Mfg. Co. and of the Howell Electric Motors Co.; inventor of the Bailey Electric Lighting, Starting and Ignition System; director of the Bailey Electric Co. and of the Fremont Motors Co., as well as Vice-President of the latter. He is a well known author and authority on electrical engineering subjects.

It appears entirely probable that the use of radio will become almost universal. I shall be surprised if within a few years radio telephones are not more common than wire telephones. By this I do not mean they will be used as wire telephones are to call up the grocer or the butcher, but I mean they will be installed as receiving outfits to listen to concerts, news bulletins, etc. An outfit to receive over short distances can be built for an incredibly low price and one capable of receiving thousands of miles can be built for less than the price of a phonograph.

The vacuum tube has also found a place in power engineering as a means of transforming from direct to alternating current or vice versa. They are built now to perform this service in small units, but it appears altogether probable that within a few years they may be built in the largest commercial sizes. At present to transform an alternating to a direct current requires an expensive piece of rotating machinery. The advantage of substituting for this a simple vacuum tube with no moving parts will be obvious. If this works out as it apparently will, it will not be at all surprising if our suburban electric cars and possibly our city cars as well are fitted to take alternating current at high voltage from the trolley wire and by means of a transformer and a vacuum tube, transform it on the car to direct current. If this can be done it will remove one of the stumbling blocks in the way of development of electric traction, particularly the heavy traction of electrified steam roads. The alternating current has great advantages for transmission but the direct current is decidedly superior for use in the motors for this particular service. This combination which will probably be worked out will be almost ideal.

I expect in the near future to see a great increase in the size of central stations and in the use of central station power rather than of power generated by the user. In addition great economies will be effected and much greater reliability given the service by the inter-connection of power plants by means of high tension transmission lines. It is not too much to expect to see the whole eastern part of the United States served by one huge transmission system with numerous stations all discharging their energy into a common net work of wires. Among other things this will permit the complete utilization of water powers which in many cases are now unavailable on account of the periods of low

(Continued on Page 55)

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Getting at Facts About Our Machine Tools

Unique Experiments Being Conducted At a Large Municipal University

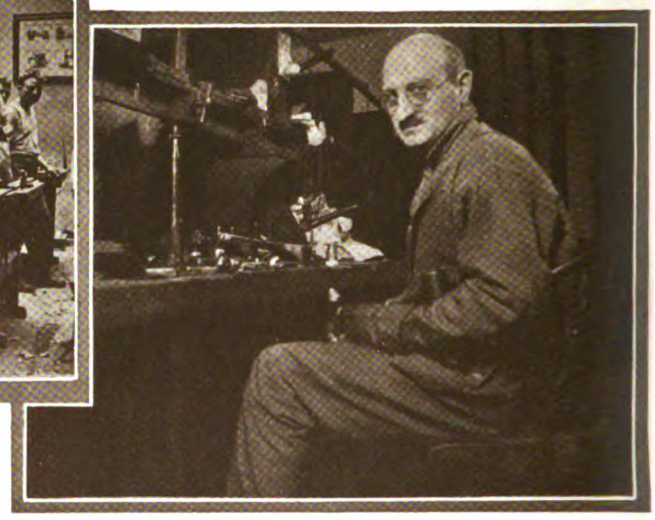
BY FELIX J. KOCH



It may seem a far cry, from laboratory experiments to watch-case assembling; yet the latter will undoubtedly benefit by the results of these researches.



There are endless problems to unriddle. The basic science of machine tools stands today where the steam engine stood just before Watt took hold of it.



Diamond cutters and polishers still employ very nearly the same tools as were used in the time of King Solomon.

IN a quiet little laboratory of the Engineering Building of the big Municipal University of Cincinnati, Professor A. L. Jenkins is conducting some unique experiments with machine tools.

He is trying to find exactly what a tool does when it does some of the simplest things known to the machinist's arts. He is asking his assistants some exceptionally rudimentary questions,—things such as:—

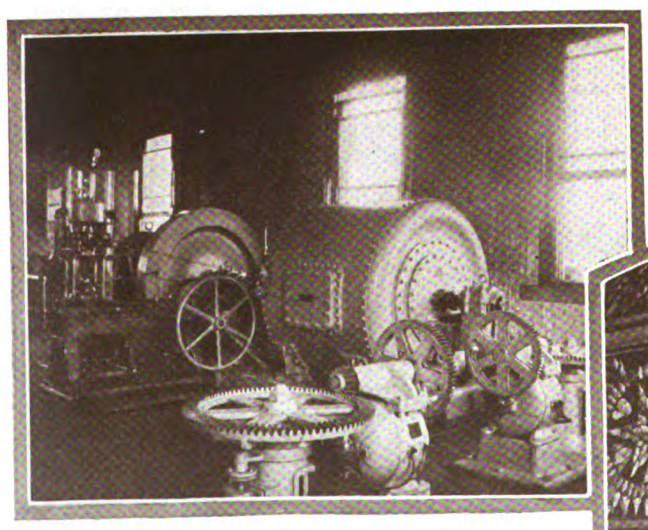
"Exactly what happens when you cut a piece of metal?" And he assures us that not only these graduate students and their directors, but he himself, and men of the caliber of Dean Schneider, head of the Engineering College and father of the "co-op" system in this country, are having a very hard time finding out!

It seems incredible, until you stand by and watch. The astronomy department has contributed what it can of the original whence of the matter which goes to build our earth.

(*Continued on Page 26*)

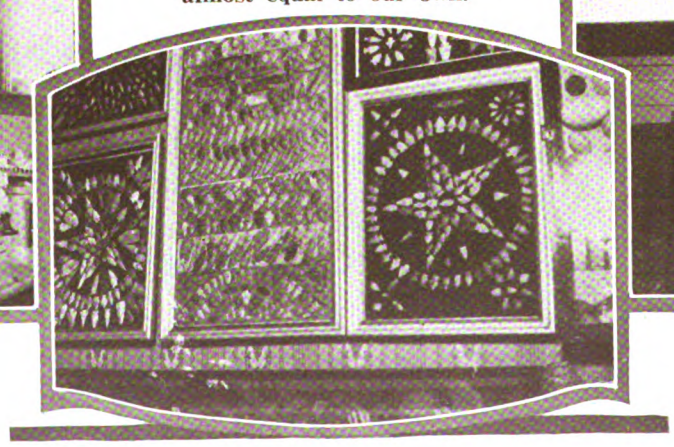


The airplane pilot, dependent for his very life on the functioning of intricate parts, will benefit materially from a better knowledge of machine-tool science.



Pumps, valves, gates—the whole science and practise of hydraulic engineering is intimately concerned with the knowledge of machine-tool science.

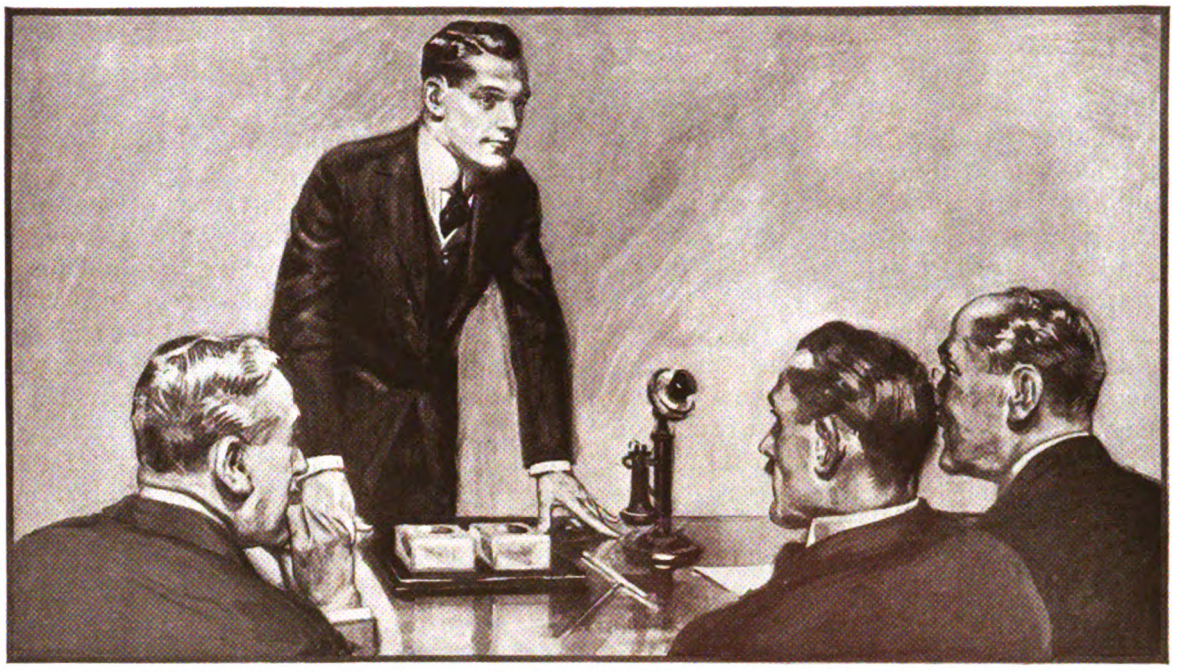
Primitive man, with his spear and arrow-heads, showed a knowledge of the principles of cutting-tools almost equal to our own.





More miles per gallon, more value per dollar of manufacturing cost—these are two of the results aimed at, in digging down for basic principles.

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This actually happened in a directors' room

It helps to explain why executives are turning to the Alexander Hamilton Institute in larger numbers than ever before

IN THE QUIET, almost luxurious, directors' room the department heads of a certain large manufacturing company were called together by the general manager.

One after another the production manager, the purchasing agent, the head of the planning department and the sales manager expressed themselves. The burden of each man's excuse was the same: "If I had received proper co-operation from the other departments we would have met our quota easily."

The general manager spoke last, a keen, aggressive man of thirty-eight, who had been brought in from the outside.

"Gentlemen, you have told me far more than you imagine," he said. "It's perfectly clear what is the matter with this concern. You men have forgotten that it is *a business* and not merely a collection of departments. You are first-class specialists, crackerjacks in your own departments, but

Gentlemen, you are mighty poor business men"

They were too stunned to answer.

"I'll repeat it," the general manager said, "You—all of you—are poor business men. You're a group of stars but you aren't a team. Each of you knows his own viewpoint; he knows his work and knows it well. But you do not know enough about each other's problems to make this company an effective business unit.

"The sales department has got to know more about production, and accounting and costs; the production department has got to think more in terms of sales and credits—each one of you has got to get some *vision of business as a whole,* in all its varied and inter-related departments. That's what this company needs—and it needs it badly."

The next day, at the general manager's invitation, a representative of the Alexander Hamilton Institute visited that office; and every department head enrolled for the Modern Business Course and Service.

More than 24,000 Senior Executives enrolled

The Alexander Hamilton Institute was founded by a group of business leaders who recognized that modern business was tending to produce specialists rather than to develop executives.

Its appeal has been always to successful men, to men of mature years who had already made a favorable start in their chosen line of work. More than 24,000 executives have enrolled with it, many of them in company with their most trusted associates.

This is the significant thing, however: *In the past six months the number of enrolments received by the Institute has been larger than that at any similar period in its history; the average age of the men enrolling has been higher; their present position in business higher on the average than ever before.*

As never before, the *leaders* of business enterprises are demanding better business training for themselves and for the men on whom they most depend.

Will you spend an evening with the facts?

The facts about the Institute's Course and Service are condensed into a booklet that aims to answer every question which a thoughtful, ambitious man is likely to raise.

To promote a wider understanding of its training, its purposes and its results the Institute offers a copy of this booklet to any reader of this publication who will request it. In a single evening you can have the full facts. The booklet is called

"Forging Ahead in Business"

Just what the Modern Business Course and Service is and does; just how it has helped to solve the problems of hundreds of business in every line; just how individuals have used it to increase their own progress and earning power—all this is contained in "Forging Ahead in Business." It is a book worth adding to any business library; for your convenience in sending for your copy a coupon is attached.

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Getting the Facts About Our Machine Tools

(*Continued from Page 24*)

and which goes, therefore to make the ores from which come the metals which make both the things to be cut and the tools. The chemistry department is lending its aid to show just what happens when the heat of friction from cutting affects the metals involved. The physics department is contributing expert advice on the inter-relations of molecules and atoms. The professors of mathematics are working on the laws of action. There are staff meetings of the experts, ever so often; but they are frank to admit that, simple as are some of the questions, Professor Jenkins propounds, in the interest of the machinery world, they are to be classed with the things which "no feller has yet found out!"

"Just how are you seeking your answers, and just what will they mean to the big, non-college world?" we asked Professor Jenkins in his office, overlooking Burnet Woods and the other university buildings, while students in hundreds, attracted by the co-operative courses offered free here, passed back and forth outside.

"Answering your question hind-end foremost, in order to dispose of the shortest section first," he replied, pointing toward the shops where still other students were engaged in more elemental practice, "even the slightest discovery here will have an incalculable effect on the designing of all forms of machine-tools to be used the machinery world over. Metal and wood-working machine-shops both may be completely revolutionized. We will know how to cut material with minimum waste of power; we will know what we are doing."

Professor Jenkins is a powerful man; he's the sort of man Nature seems to have intended for directing giant lathes and bossing crews at giant derricks and things of that sort. He swung about in his swivel-chair.

"It doesn't seem possible, when you remember that tools are as old as civilization itself; but if there is one thing Man doesn't know anything at all about, it's the tools used in everyday life. Since even the keenest scientist knows nothing about what just those simplest tools DO do—just what a saw does when it cuts woods, and why, for one—you can guess for yourself what we know about the rest."

"The history of the development of any branch of engineering seems to show that it has progressed in proportion to the rate at which its underlying principles were made plain to all; then related, one to another; and then expanded to produce fundamental laws, which were expressed with mathematical exactness and so reduced to a science.

"Consider the steam engine, just as an example," he suggested. "The development, in the first stages, was very slow. The fact that steam will exert pressure was the first principle to be known here. Then it was discovered that steam could be used to create a partial vacuum, by causing it to condense in a closed chamber. The entire progress of steam engineering hung very largely on those two principles until 1769, when James Watt conceived of several others, which were readily developed into working laws. Once, though, the fundamental laws of the properties of steam,—of the mechanics of materials and methods of production, and of what we call 'thermo-dynamics' were developed, and expressed in mathematical forms, the development of steam-engineering progressed by leaps and bounds.

"Of course," he admitted, catching a touch of doubt on our features, "you'll suggest and I'll admit that the steam engine and the entire field of steam engineering, including even the heating of buildings by steam, MIGHT have been developed to a considerable degree as a result of necessity. It is, however, undoubtedly true that the present development could never have been achieved, without the *application* of the principles involved. The internal combustion engine, I admit, was conceived by Hugens away back in 1680; but, due to the lack of scientific knowledge of thermo-dynamics, mechanics and the chemistry of combustion, the perfecting of this engine required more than four centuries."

He looked about him to where a series of panels, hung to rotate on a central bar, have not simply a schedule of all courses in the department over which he presides here, but also tell the exact topic of the day's discussion in each,—a novelty in the college-world, so far as the local folk happen to know. His eyes lighted on the title, AERONAUTICS, and he used this to emphasize the theme at hand.

"The phenomenal present day progress in the development of aviation," he put it "is due to the correlation of the principles and the interpretation of scientific laws, almost throughout.

"For an infinitely long time, machine-shop methods had been developed very slowly on an almost legendary knowledge, handed from father to son for many centuries. It is true that almost all mechanical engineering work is done in shops, and the greater part of the operations performed in doing this work involve the cutting of materials. Millions of persons have spent most of their lives in cutting metals and other materials. Great improvements in tools and in methods have been made, largely as a result of some sudden flashing home of an idea; and so it might be argued that as things were and *are,* they may as well continue to be. It is truer still, however, that our present knowledge of the fundamental laws invoked here is woefully insufficient to enable us to predict even the direction in which we expect to make our further progress.

"The labors of Nicholson, Taylor and Smith are meritorious, and important to a high degree, but they establish very few fundamentals.

"You see," he explained, leading the way down a corridor to where students were at work with varied sorts of steam-engines, "just as soon as the principles of thermo-dynamics were reduced to mathematical laws, it was possible to imagine an ideal engine, and to established a rational basis to use in comparing the performance of some existing engine with that of this ideal.

"By comparing the existing engine thus, it became possible to state the efficiency of another machine of the same sort; and thereby relieve the builder of the notion that he had produced an engine of the highest possible efficiency, when he had really only built an engine that was to be twice as efficient, say, as the average engine on the market.

"De Leeuw, one of the master minds in his field, once asked us, 'What are the things we should know about tools,—machine-tools particularly,—to enable us to make these follow the line of development which the steam-engine has enjoyed? Is it possible to develope a theory of the ideal machine-tool, such as has been developed for the steam engine?'

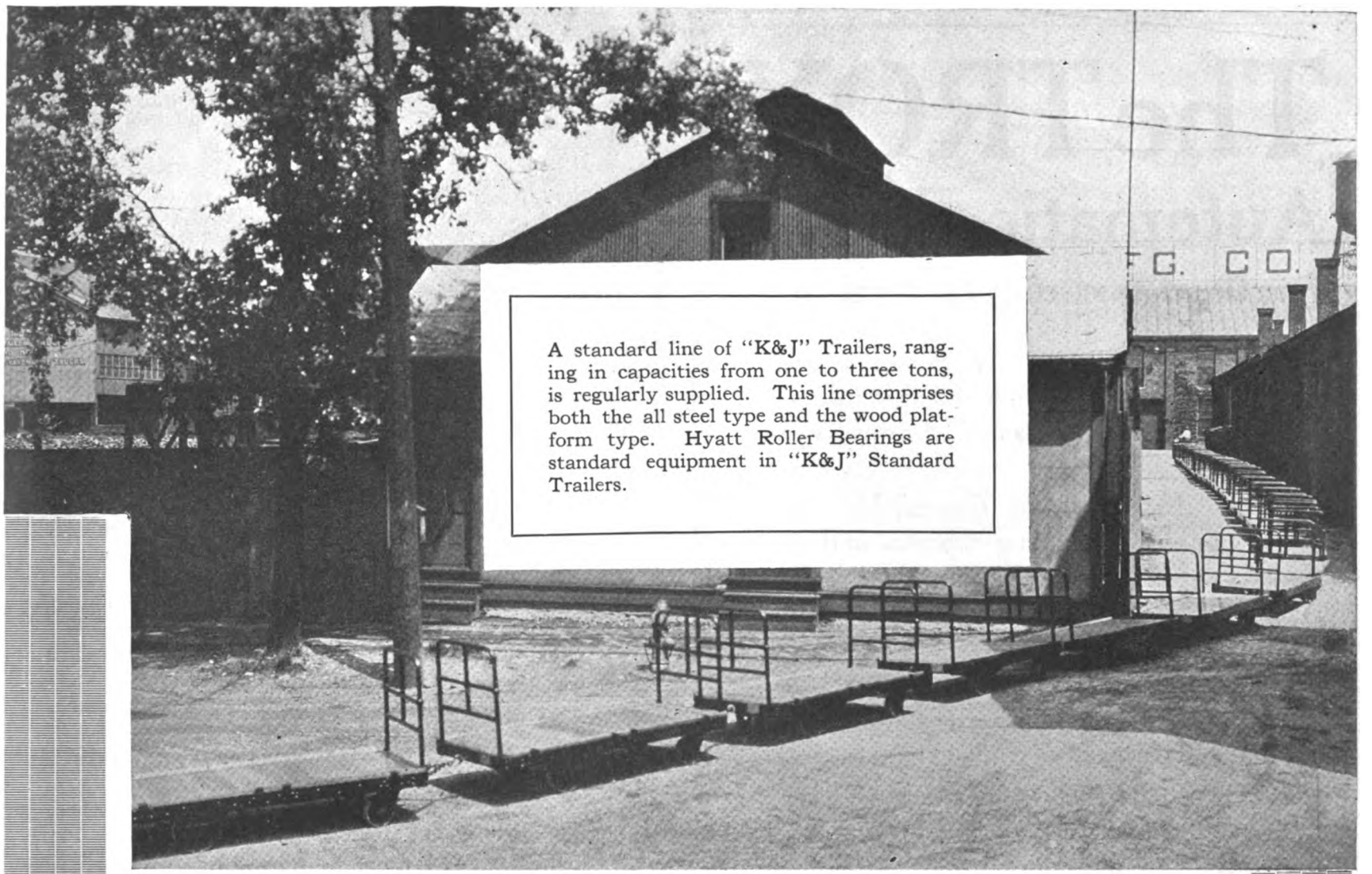
"After discussing the energy required to produce a failure with some object out of steel, by subjecting this to a tension load and then assuming a reasonable time-element for its stress, he reached the conclusion that 'If the only function of a machine-tool is the removal of metal, we would find that our best machine-tool has an efficiency of from .12 to .22. Even the better of these figures is very low when compared with the efficiencies of other machines.'

"Now efficiency is, of course, just a ratio to express a comparison;—and the value of the efficiency depends on the nature of the comparison. The values which express the thermal and the mechanical efficiency of engines differ enormously; hence it is necessary, first, to specify the terms to be compared. To illustrate:—

"Nicholson's theory of the efficiency of a lathe was not the mechanical efficiency of the headstock, but an efficiency which would compare those items in the specification for a lathe that is of economical value to the purchaser. He set aside such standards of comparison as 'maximum pulley-diameters,' 'minimum pulley-diameters,' 'maximum gear ratios,' and the quantity of belt passing over the pulley and considered the spindle-speeds, in the matter of their range and progression; also the number and ratio of back-

(*Continued on Page 28*)

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A standard line of "K&J" Trailers, ranging in capacities from one to three tons, is regularly supplied. This line comprises both the all steel type and the wood platform type. Hyatt Roller Bearings are standard equipment in "K&J" Standard Trailers.

Part of An Order for "K&J" Industrial Trailer Equipment Being Assembled for Shipment

Big production—such as the normal "K&J" Industrial Trailer production—offers the buyer several important advantages.

Experience in designing and manufacturing increases with every lot manufactured. Experience in truck and trailer production has been piling up within the "K&J" Organization for more than forty years.

Responsibility increases as volume of production grows. The foundation beneath the reputation and prestige of each manufacturer is built of his products. A faulty product is a weak stone in this foundation; one that no great manufacturer can afford to permit. Therefore, quality and fitness in every "K&J" Industrial Trailer is a responsibility we owe to ourselves as well as to our customers.

Economy in manufacture and lower prices to the buyer result from big scale manufacture. The "K&J" Organization is the logical place to look for the most favorable prices consistent with fitness and quality.

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The Kilbourne & Jacobs Mfg., Co.,

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The TROY Automatic Engine

For Direct-Connected Electrical Work

The TROY VERTICAL Steam Engine illustrated below is most suitable for use, direct connected to small electrical generators.

Its well balanced and dependable construction, the self oiling features and the TROY Record of thirty-one years, building "Only Steam Engines; Good Engines Only" has made this TROY Engine one of the best small prime movers in use.

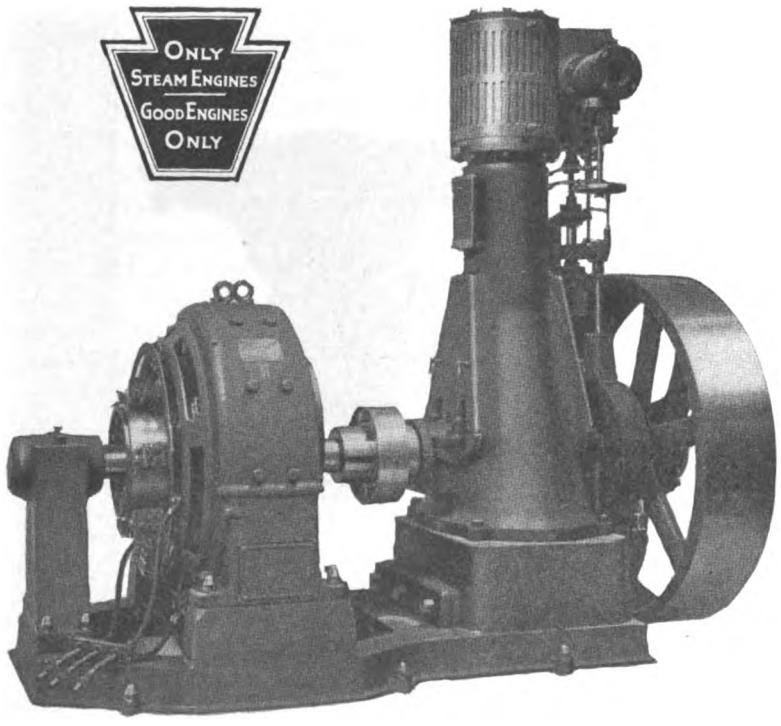
The TROY Automatic Direct-Connected Engine is furnished with extended subbase and complete coupling but we can also furnish outboard bearing and armature shaft if ordered. The engine is built to suit any standard make of generator.

TROY ENGINES are also built Horizontal. We specialize in steam engines from two to two-hundred Brake-Horse-Power.

Our booklet No. 6 describes them fully. Write for a copy.

TROY ENGINE & MACHINE COMPANY

TROY, PENNSYLVANIA



(Continued from Page 26)

gears and counter-shaft speeds; then the size of the cut that may be taken at the various speds.

"This sort of problem is necessarily a complex one and the methods required by it involve many details which might be criticized in certain quarters; but he has made it possible to at least estimate the value of any given design of headstock relative to a standard of reference, and to express this value numerically, in terms of the cost of machining a unit of metal.

"This method consists essentially of comparing the metal-removal rates obtained from speed-torque diagrams drawn for the machine considered, and for a machine representing certain standards.

"What follows, then, is merely a matter of carefully executed formulae."

"We have these formulae, and many more are being compiled,— but there's been precious little done toward advancing our knowledge of tools, when it comes to putting such facts to practical use," he said.

"When we come to fundamental facts about the actions of our tools, we really know next to nothing at all. Take just the matter of the relation between the feed, cut-speed and depth of cut,—a typical fundamental principle. On this subject at least twelve equations have been worked out—and they not only don't agree in numerical values, but their very forms fail to agree. One man has the cut-speed varying to one part of the depth; another as to the other. We know that there must be an underlying principle there, but we don't know what it is. Smith, Herbert and Nicholson each give us different equations; but no one has determined just which is the correct one."

"And when we do get the major number of these formulae firmly fixed, then what?" we asked, wondering what might lie beyond all this, in this far flung field of mechanical science.

"Then,—well, of course, we can imagine an ideal engine, and we will keep comparing the engines of the day to this one. We will know the efficiency of the ideal engine; we will find the exact efficiency of a given engine, and show i builder how far he comes fro perfection here. We wi know, absolutely, the limita tions of our engines. We a limited by the exhaust temper ature of steam. We canno expand that indefinitely; bu we will know the limit to whic we CAN go. We will hav had determined for us othe recognized losses."

"Which may lead on to ..." again we parried.

"A search for some ne things to substitute for stea in expansive work. The law of thermo-dynamics have bee so thoroughly covered tha there are not a great many un knowns left. Some of thes will be explored then. We wi learn more about the inflow engine, for example; we wi get more results from its con densation and evaporation i the cylinder.

"We haven't reached th limits with steam; near to the though we seem to be.

"Just now you know," an the Professor touched on subject dear to his heart, b of which he is still telling lit tle, "the *live* things for exper imental work is the internal combustion engine. The exac workings of the carbureto the part such an engine ca still be advanced to doin with the automobile, the gas engine, the oil-engine—they provide an infinite field for work. Getting such an engin to give more miles per gallon with the automobile,—to yield more horse-power per unit, i the stationary engine, is the task assigned.

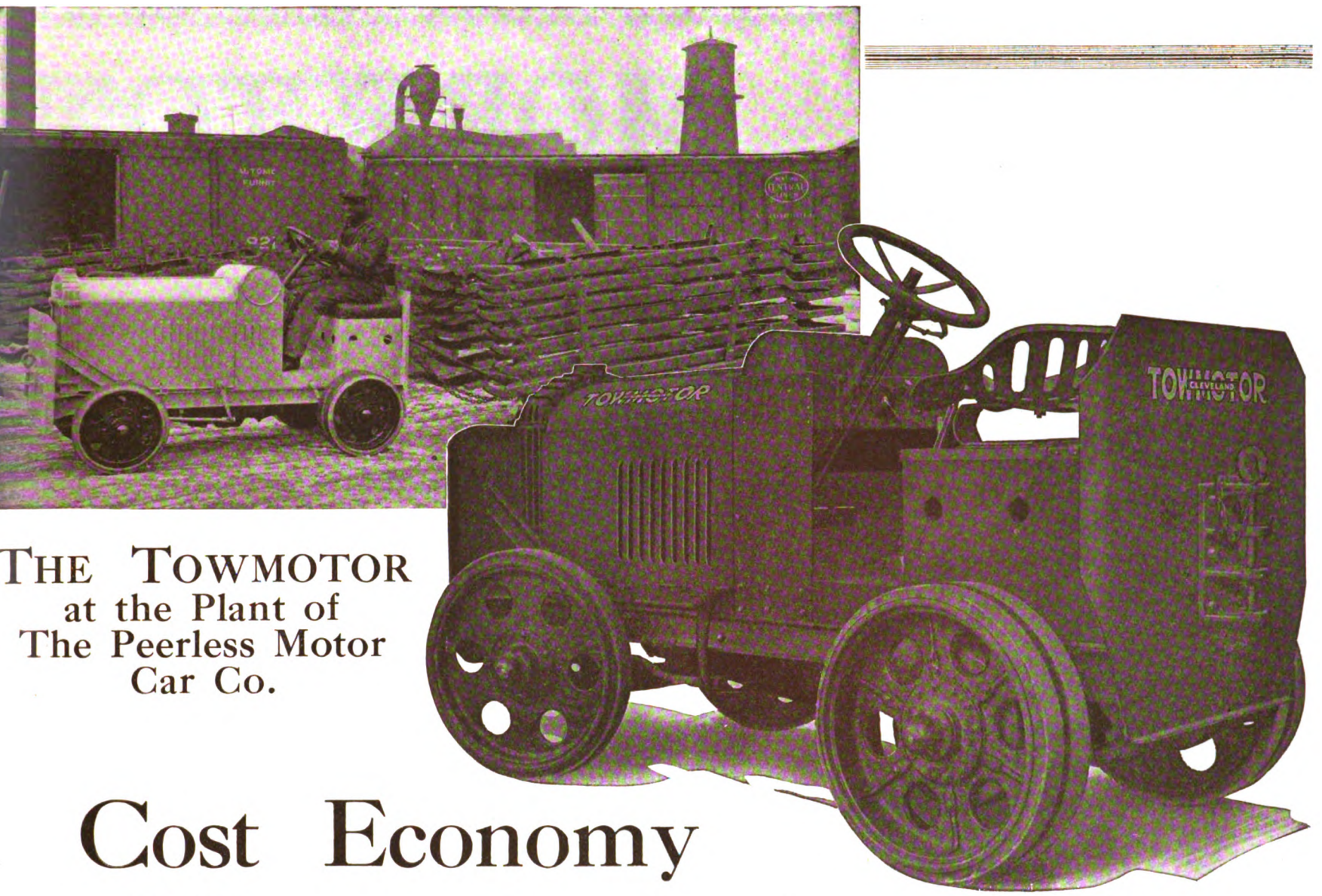
"It's not a matter, then o increased efficiency in the in strument itself, it's a matter of using that instrument and yet getting the same,—or still more work with cheaper fuel. Remember, we've the diminishing coal and oil supplies to look ahead to.

"And all of these things go back to the initial thought: all of these machines resolve themselves to parts; and all of those parts must be shaped by tools; and the better these tools, the better these wares.

"The science of machine-tools stands today where the steam-engine stood just before Watts took hold of it. We must find a theory for an ideal machine-tool, as Watts did for the ideal steam-engine.

(Continued on Page 32)

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THE TOWMOTOR
at the Plant of
The Peerless Motor
Car Co.

Cost Economy

Where Production Starts

In the automotive industry every step of the productive process is carefully watched. Competitive methods do not allow any wastes. Sales are based on keeping production costs to the absolute minimum.

But efficiency in production does not end in the plant. The heavy haulage of raw and finished materials is also considered and efficient haulage is a necessary item in maximum production at minimum cost.

That is why The Peerless Motor Car Company has been using THE TOWMOTOR to solve its haulage problems and that is only one example among thousands.

THE TOWMOTOR is a rugged self contained power unit. It is an industrial tractor, driven by a gasoline engine. THE TOWMOTOR is a rugged, all steel machine, built of the highest grade standard units. It is not a remodeled automobile, but has been especially designed to fulfill the demands of the heavy duty 24 hour uninterrupted service and the maximum demands of industrial haulage.

There is sufficient power in THE TOWMOTOR to move freight cars and still operate economically in hauling light loads. It is equipped with a governor which allows efficient operation at any speed from 1 to 15 miles per hour.

THE TOWMOTOR is sold with a liberal guarantee. All parts are absolutely guaranteed against defects.

Whatever your requirements may be we are sure we can prove to you that THE TOWMOTOR will reduce your haulage cost considerably.

Write to us for further information.

THE TOWMOTOR COMPANY

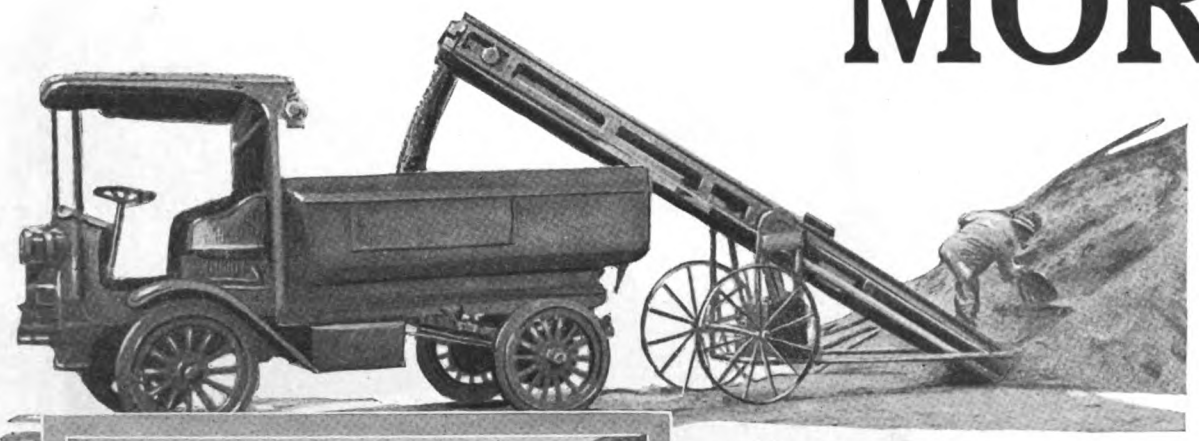
CLEVELAND Collamer Ave., and 152d St. **OHIO**

THE TOWMOTOR

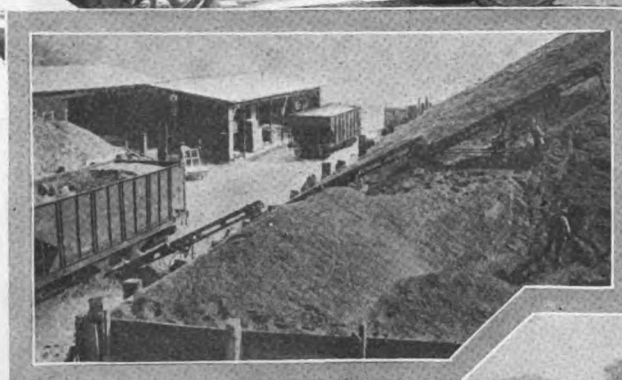
A Gasoline Industrial Tractor

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MORE TONS



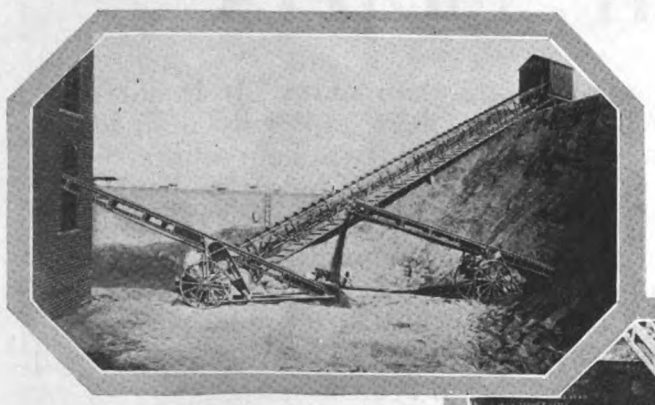
ABOVE—Loading coal into truck at the Campbell Morrell Co., Passaic, N. J. Note ease of feeding.



ABOVE—The flexibility and economical operation of these machines at the Gera Mills, Garfield, N. J., enable them to save a large amount of money in unloading their coal from cars to storage and then reclaiming to boiler room.



ABOVE—The Scoop Conveyor loading an electrical truck trailor for delivery to boiler room. This is an ideal installation where coal is received at a distance from the boiler room.



ABOVE—Two Scoop Conveyors in tandem style reclaiming coal direct from storage pile to boiler room at the Standard Oil Cloth Co., Athenia, N. J.

BELOW—Loading cars at the Carnegie Steel Co., Mingo Junction, Ohio.



Operating Cost of
Guaranteed Not to Exc

WAS ever a portable conveyo amazingly economical as this Scoop Conveyor?

Ever since its debut 6 months ago conveyor has been subject to an ov in which Europe and America have jo

Now, with more than 500 of the Models in the hands of owners, the adv favor and faith in the Scoop Convey repaid, we believe, by the reliability ord it has established.

As owners of preceding models hea testify, the Scoop Conveyor has al been singularly economical to operate

But reports from owners show that models are operated for less than ha the operating cost of any previous S Conveyor.

Even this pointed tribute to the model's economy is overshadowed by positive expressions of praise from ow

Write

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PORTABLE MAC
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ER DOLLAR

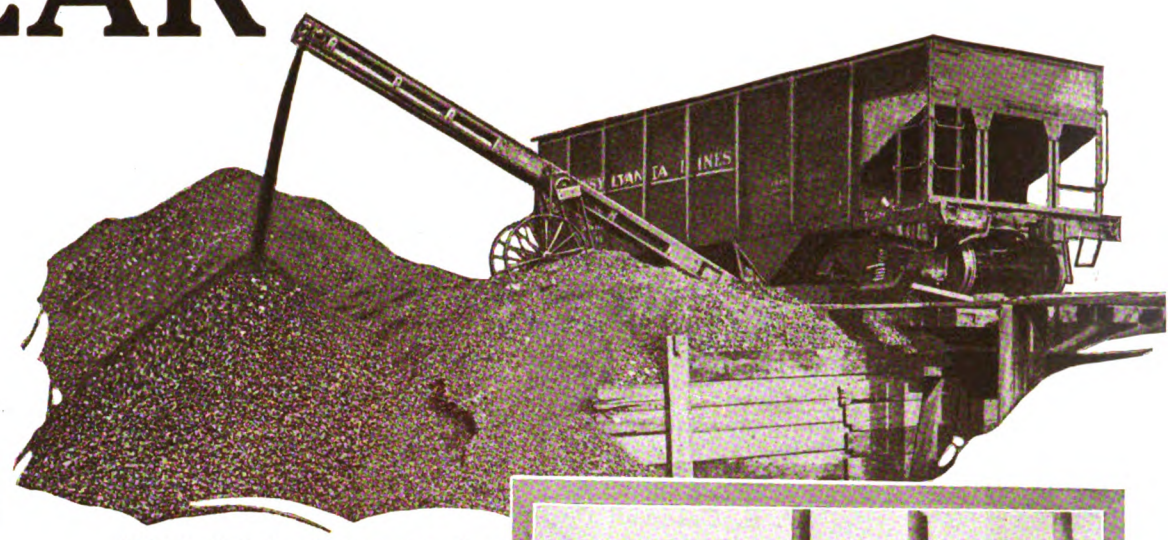
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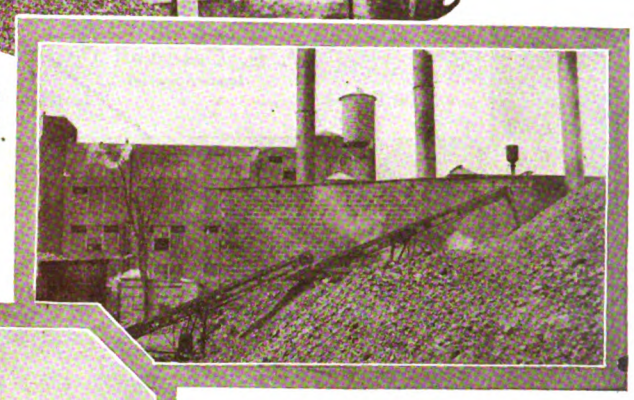
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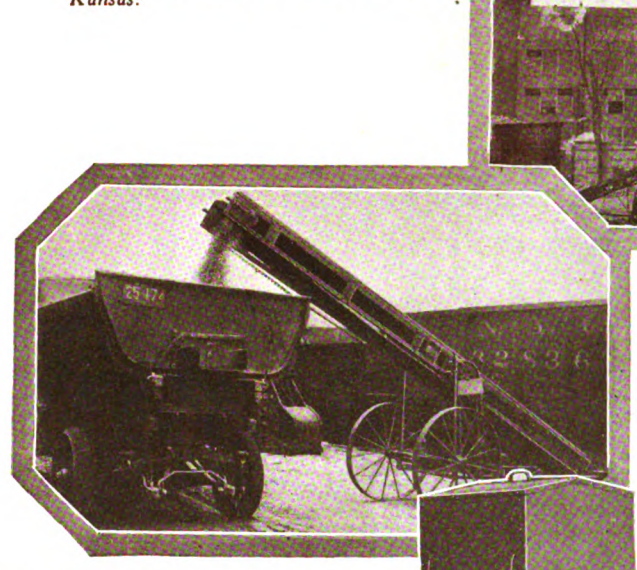
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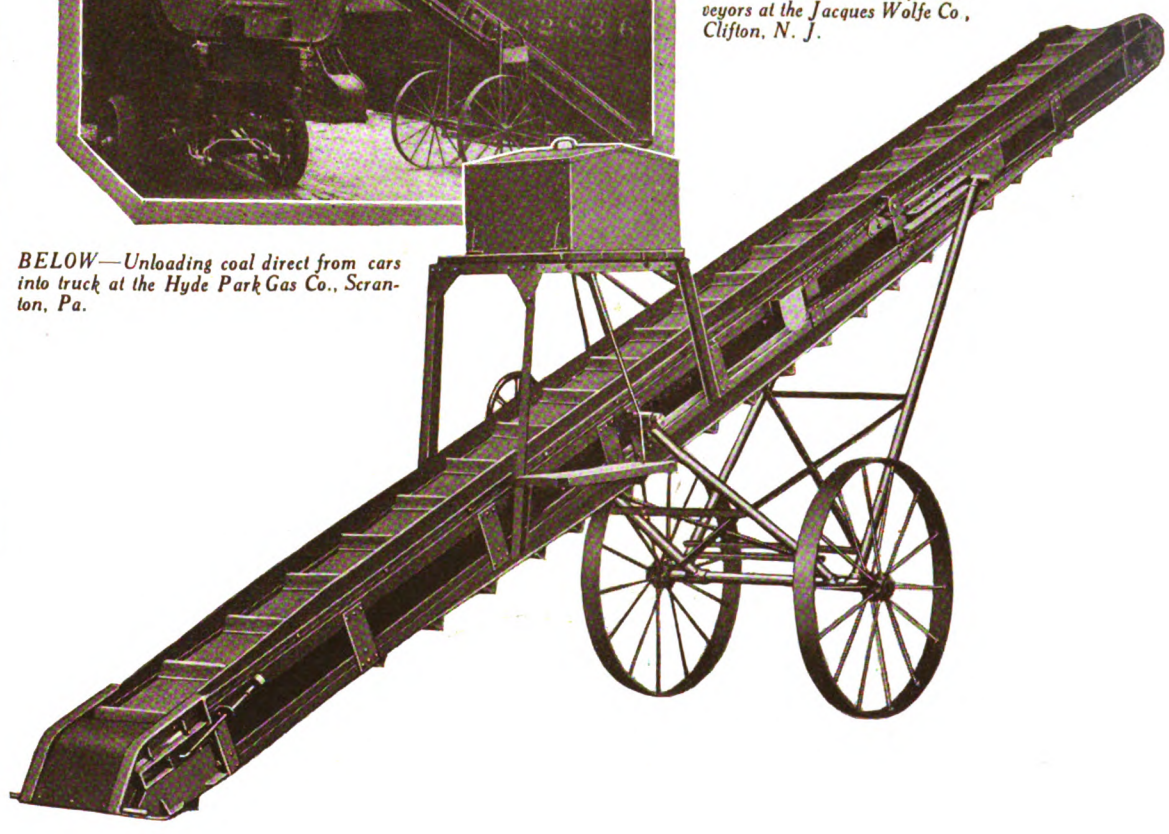
ABOVE—Unloading 50 ton cars in three hours at the Carey Salt Co., Hutchinson, Kansas.





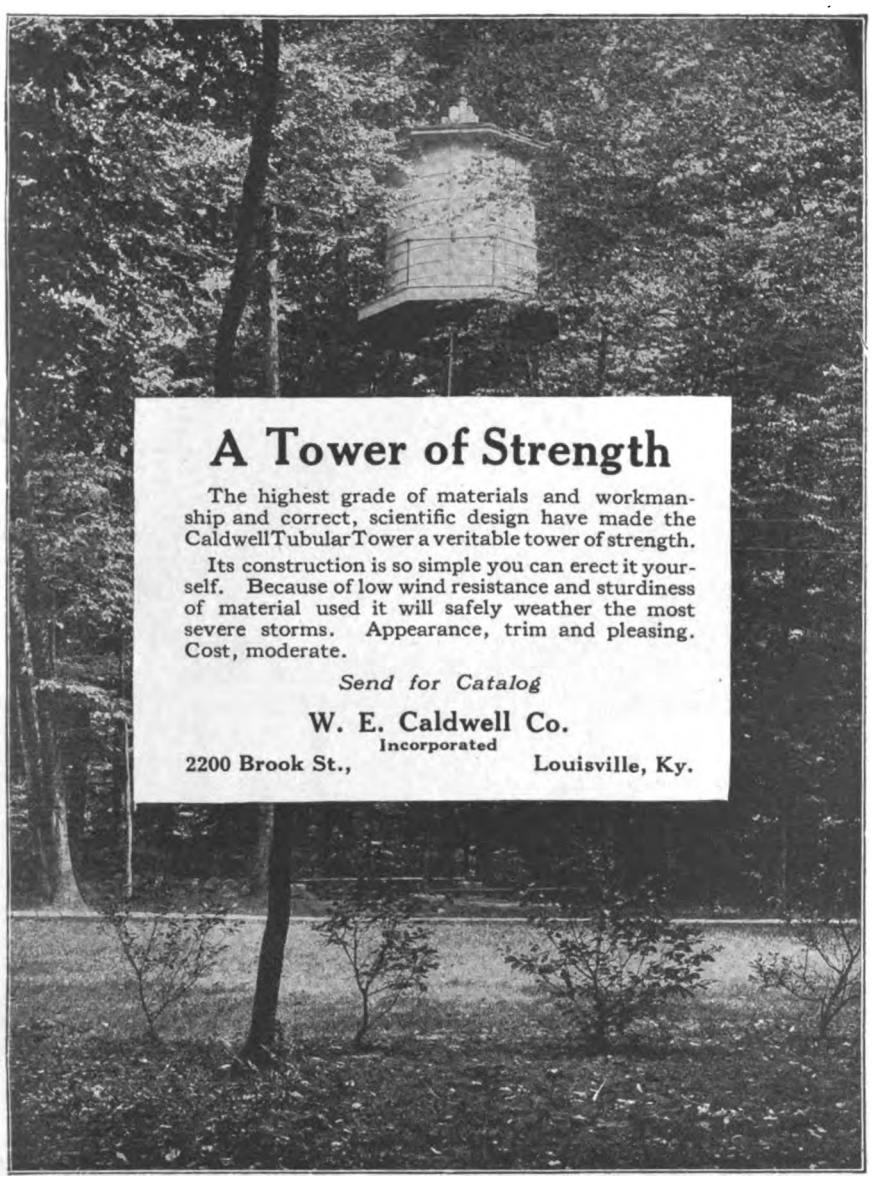
ABOVE—Unloading and Storing Coal with two Scoop Conveyors at the Jacques Wolfe Co, Clifton, N. J.

BELOW—Unloading coal direct from cars into truck at the Hyde Park Gas Co., Scranton, Pa.

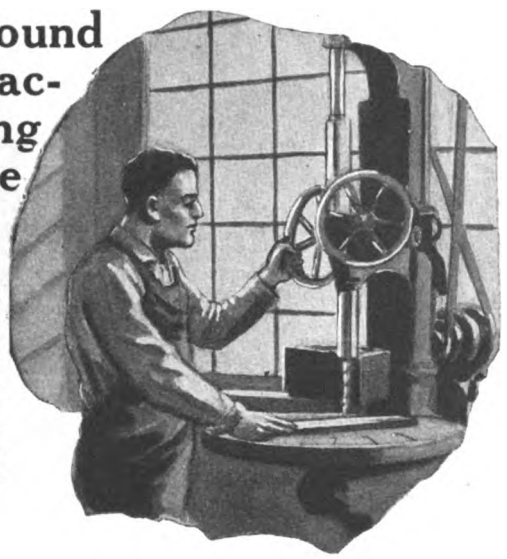


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"—and have found it very satisfactory in reducing the *glare* of the summer sun."



The H. H. Franklin Mfg. Co., of Syracuse, N. Y., have applied BLU-EE to a considerable area of factory sash with wonderful results. It reduced the glare of the sun's rays and produced a "cool, pleasant light inside the factory." An example of hundreds of satisfied users.

BLU-EE Cuts Out the Glare
TRADE-MARK

It is not a mere question of comfort, but glaring light causes eye strain and retards production to a great extent. ¶BLU-EE keeps out the heat and glaring rays. It only allows those rays to penetrate which give a diffused, filtered light, restful and beneficial to the eye, helping the workers do better work. BLU-EE is easily applied with a paint brush. Easily removed when you wish. ¶Fill in the coupon below and send it in today. This will convince you what BLU-EE will do for you.

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Try It Out—We Run the Risk

PLEASE send me 2 packages of Blu-EE, sufficient to cover 2000 square feet of glass. It is understood that I am to use one of the packages as directed and will remit $5.00 for both if I am satisfied with Blu-EE, and if not entirely satisfied may return the other within sixty days and you will cancel this order.

Firm Name..... Position.....

Your Name..... Address.....

(Continued from Page 28)

"Mind you, I say, we must find a *theory*. No one can conceive what the ideal machine-tool would be. With any metal-cutting tool, the largest part of the energy consumed is used in starting the chip. Once the chip is removed, the big part of the work consists in shearing, pressing, extending and the like. We know now what it costs us to do this with the finest tools to hand. We want to determine what it would cost with an ideal tool. Then we will work towards that goal."

To determine these facts, Professor Jenkins has set men to work at some of the finest and latest machines for such work in the world. One such instrument alone came to $5000 when purchased not long ago!

The men, though, are discovering that they have stepped into the middle of the story; that they must get back to the start. They must start, that's to say, with elementals.

The men, as they come to this conclusion, are being sent to the metallurgist, then the chemist, then the geologist, the physicist, and eventually the astronomer, to learn beginnings. They are going to learn exactly what occurs when tools do their work.

In other words, they are going to ferret out the very fundamentals of the Big Beginnings. These secrets disclosed, they will turn in their tracks and, employing the rare, costly knowledge so gained, they will immediately set themselves to the tasks of conceiving, then approximating, and, eventually—speed the day, of course—*producing* actually PERFECT tools of whatsoever the sort!

The Making of a Filament Lamp

(Continued from Page 13)

heated in an electric furnace which welds the fine particles together into a solid mass. Then the ingot is "swaged"—placed in multiple hammer machines which hammer it on all sides at the rate of 12,000 blows per minute. The ingot is passed successively through some thirty of these swaging machines until it becomes a rough wire of ductile tungsten, 65 times its original length. The tungsten wire is drawn through a series of dies of diminishing sizes until it has the correct diameter—and the diameter varies for lamps of different wattages. The diameter of the wire is determined by weighing a definite length. The drawn wire is spooled and sent to the lamp factory.

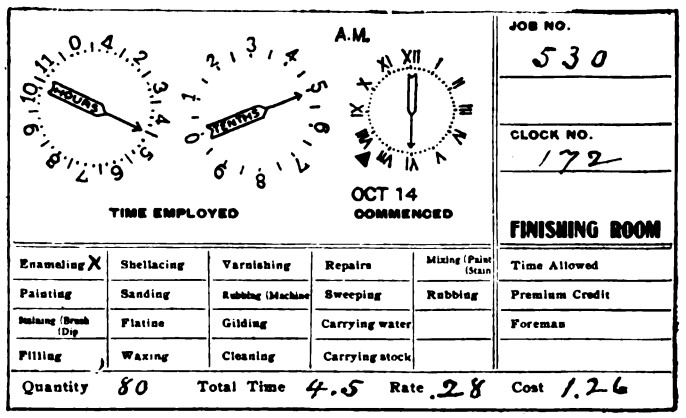
"Lead" wires, the wires which carry the current into the lamp, are made of copper wire, except for a small portion known as the "press-lead." This is of a special composition which has the same contraction and expansion characteristics as does glass. These wires are made in a separate factory and are shipped to the lamp factory.

The bases of lamps are made of brass, which comes to the base works in bandage-like rolls. From these rolls machines cut small disks which a series of dies gradually form into cup-shaped shells. These shells are threaded by stationary and rolling dies and are conveyed to other presses where the ends are punched out. Other disks, cut from strips of brass, are punched through the center to form eyelets. Then the eyelet and the shell are insulated from each other by molten glass, the glass being poured into the shell and around the eyelet. And the finished bases are sent to the lamp factory.

The lamp factory is the assembling plant. Here the various lamp parts meet for the first time. The glass tubing is cut by machines and heated at one end so that a mechanical finger can flange it. The cane glass is made into "button rods," into the ends of which are inserted hooks on which the filament is wound. Then the flanged tubing, the button rod and the lead wires are assembled to form the "stem," which supports the filament of the lamp. The lead wires are

(Continued on Page 34)

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The Calculagraph Way

One backward-forward movement of the right-hand Calculagraph lever when the job starts, a pull on the left-hand lever when the job is done, and the time record is complete.

The elapsed time can be read directly from the card. Without any figuring or possibility of error.

Any number of employees can use one Calculagraph without confusion of records.



This Record— Can't Be Faked

When a Calculagraph is used you can feel confident that your time records won't be faked. The hands on the clock can be manipulated----but setting the hands on the clock face of the Calculagraph will not in any way change the elapsed time record---the movement must actually run to compute elapsed time.

The Calculagraph is a spring-driven, self-contained instrument; there are no wiring or electrical troubles with consequent high maintenance cost.

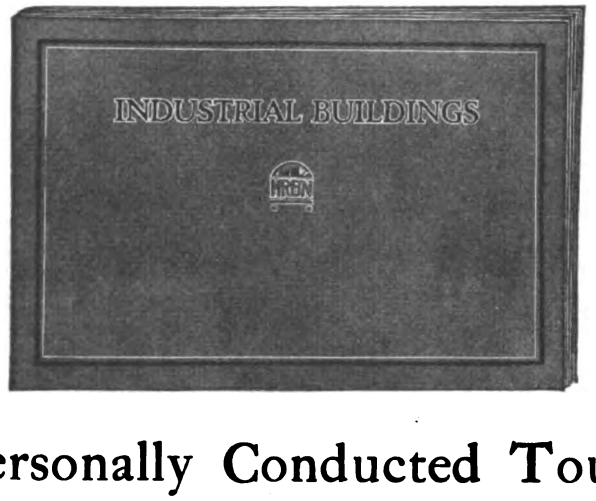
There is no figuring with this machine---- the calculations are all mechanical, and its construction will enable it to withstand the hardest usage.

Send today for your copy of "Elapsed Time Records"

THE CALCULAGRAPH
THE ELAPSED TIME RECORDER

34 Church Street **New York, N. Y.**

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A Personally Conducted Tour *of* Inspection *for* Factory Owners

WOULDN'T a trip through twenty-five modern industrial plants, including factories, foundries, forge shops, machine shops and power plants give you some good ideas to use in your own plant?

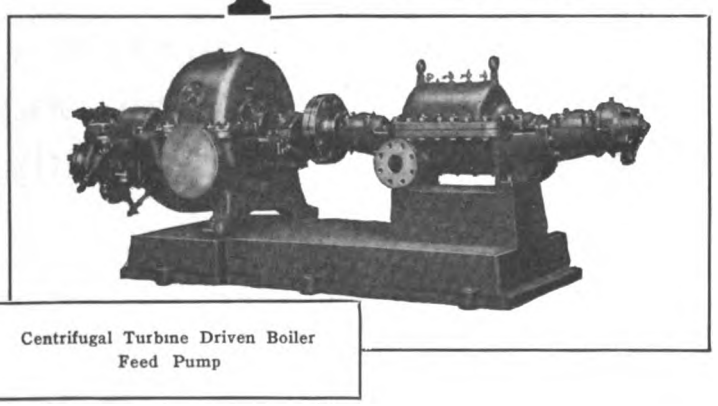
That is practically what *Industrial Buildings* gives you, for it contains not only exterior and interior illustrations of twenty-five modern industrial plants, but floor plans, cross sections and plant layouts, as well as interesting facts about every one of the plants illustrated.

We are offering to send a copy of this booklet gratis to any factory owner or executive.

Write us today for your copy.

MILLS · RHINES · BELLMAN & NORDHOFF
Engineers
TOLEDO · OHIO

MORRiS
PUMPS



Centrifugal Turbine Driven Boiler Feed Pump

No water seals are necessary in the Morris horizontally split Boiler Feed Pump of 2 in. and 4 in. sizes. The impellers are arranged opposite each other—the suction is in the middle of the casing between the impellers. Thus the stuffing boxes for the pump shaft are always under pressure, so that there is no tendency toward air leaks to break the suction. This is important when the pump operates under a suction lift. ¶Your engineers will appreciate all these refinements in construction which give the assurance of continuous heavy duty. ¶Our consulting service has helped many plants in solving pumping problems. Write to us for information.

Since 1864 Builders of Dredges, Centrifugal Pumps and Steam Engines

MORRIS MACHINE WORKS
200 Genesee St., Baldwinsville, NEW YORK

(*Continued from Page 32*)

sealed at the press-lead with the two glass members of the stem. Then the hooks are inserted on both ends of the bottom rod part of the stem, and on these hooks, the filament of tungsten wire is wound—and the finished whole is called the "mount."

Then a short piece of tubing is fused on the extreme top of the bulb for removing the air later. The ragged, surplus neck of the bulb is removed and the bulb is placed over the filament mount. Hot flames are directed against the neck of the bulb on all sides; the neck draws in and forms an air-tight joint with the flange of the filament mount. Next the bulb goes to the exhausting machine where it is exhausted and sealed, or exhausted and filled with inert gases and sealed—depending on the type of lamp it is to be.

The lamp is then lighted for the first time, a felt separator preventing short circuiting of the lead wires. If it stands the tests, the base is fastened to it by cement and the lead wires are soldered to the base. And the lamp is ready for labeling, packing and distribution to the users of artificial light.

The Ever Widening Field of the Typewriter

(*Continued from Page 17*)

eral copies or originals simultaneously written. It naturally followed that the business world realized writing machines were a necessity.

"Four great fundamental steps have marked typewriter development:

1st—To write rapidly *by machinery;*

2nd—To write *visibly;*

3rd—To write *without noise;*

4th—To so reduce the weight and size of writing machines as to make them companionable—conveniently carried wherever any user may go.

"With quiet operation and portability, the field of the writing machine becomes vastly enlarged—almost without limit—not only in the office, but in the home, the school, in hotel rooms, on trains and everywhere.

"You ask of me, what may now be the 5th or next great further step in the development of writing machines?

"Certainly no limit can be placed safely upon the possibilities of invention. Marvelous, almost beyond expression, have been the telephonic and radio achievements of very recent years. Think of the means by which a man in Honolulu listened to the conversation of a person in New York with one in Paris! Will automatic writing machines some day both write and receive such messages with guarantee of accurate transcription? Will the ether waves of the radio mystically touch and guide my writing machine keys, inspired from afar by friend, associate, correspondent; and may I return messages to them in this way?

"Will the airplane and the flying boat be followed by the flying auto, so light and free as to hop from the street as nimbly as the dove takes wing, and as easily alight on street and roadway, folding its planes like the grasshopper into compass narrower than a runabout? Certainly the flying auto would need little added weight beyond an airplane and no added motive power for running on land, simply using its flying motor and air propeller and its light landing wheels provided with steering gear and brakes.

"Some day our coal supply will be exhausted. Then will the vast hydro-electric energy of the world supply us with heat, light and power far more satisfactorily, and will the unlocking of thirty-five millions of horse-power from a single river in Africa; fifteen millions from a single river in South

(*Continued on Page 36*)

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USER REPORT SERIES

2

Written by Users of B-G Machines
Audited by H. P. Gould Co.

No part of this report written, altered or even seen by Barber-Greene

Finished report as quoted here is only report which was delivered to us.

Cut Handling Costs In Half
Eliminate Shut-Downs Entirely



Sand From Bank to Plant

"Since installing a Barber-Greene Loader and Belt Conveyor, we have ***never had to shut down our plant for lack of material,*** though such shortages formerly caused expensive tie-ups. These ***machines are displacing 6 men, and saving $3902.14 a year in wages alone.*** Though used only 3 or 4 hours a day, they average 150 tons of material a day. The machines have ***also reduced our labor troubles,*** which were unusually serious because of the disagreeable nature of the work they have taken over," writes Mr. W. H. Crume, president and general manager of the Crume Brick Co., Dayton, Ohio.



Finished Product from Plant to Car

"When digging into a soft bank, the machines can handle a yard a minute, of material weighing 2700 to 2800 lbs. to the yard. An operator and helper easily handle the two machines, and have enough time to look after the stationary conveyor. The total annual operating cost of the two B-G machines is $3297.86, which amounts to only $.0732 per ton.

"The Barber-Greene Company's field engineer has been of considerable assistance in solving our problems, and the company has always given us excellent service. We would buy more of their machines without hesitation."

Write today for report number two, which gives complete cost figures on the operation of B-G Equipment at the Crume Brick Company

Barber-Greene Company

470 W. Park Avenue, Aurora, Illinois

Branches in most Principal Cities

Note—We have literally thousands of photographs showing every possible application of our flexible standardized, portable conveyors and loaders. Tell us your handling problem and we will send an illustration of a similar installation. Or if desired, one of our engineers will call. No obligation. Our aim is to reduce your handling costs.

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TEMPERATURE INSTRUMENTS
INDICATING - RECORDING - CONTROLLING

PRICES

LOWEST when continuous service without repairs and economies effected by their use are taken into consideration.

To specific inquiries we give immediate attention.

Complete *Tycos* Catalogues await your request if made on firm stationery.

One lists instruments for steam and power plants, heating, ventilating, marine engineering.

—Another for industries depending on vacuum processes.

—Another for ice manufacture, refrigeration, cold storage and industries where the primary requirement is low temperature.

—Another catalogues instruments used in brewing, bottling, malting, distilling.

—Another covers canning, packing and allied industrial requirements.

—Another is devoted solely to gas works, by-product coke ovens and gas power plants.

—Another, industries in which the principal operation requires the use of long stem, high temperature thermometers.

—Another is for the baker, confectioner and allied industries.

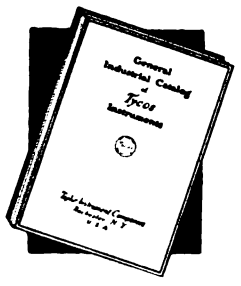
—Another covers a complete line of regulators for controlling temperature in enclosed spaces.

—Others are devoted to milk industries.

—And still others to thermo-electric pyrometry.

Taylor Instrument Companies
Rochester, N.Y. U.S.A.

Theres a *Tycos* and *Taylor* temperature instrument for every purpose.



(*Continued from Page 34*)

America; nearly five millions possible from Niagara Falls—the latter equal to all power now used in the United States outside of steamboat and railway transportation—and millions from the tides of the ocean—two hundred thousand horse-power now in progress of realization, in a simple, practical manner, from the 65 feet rise and fall of tide at the Bay of Fundy—will not these and other untold resources of nature make vastly greater demands upon the writing machine; and may we not hope that, departing from engines of destruction, the world's mind may forever turn to the arts and pursuits of peace, generous prosperity and good will?

"It must if civilization is to endure."

Wages and Wage Cuts

(*Continued from Page 16*)

A hazy idea flitted through Jim's mind that there were several hundred more workmen who had helped to buy that car. It did not enter his mind that the profit was comparatively small on each man, and that only the number of the force given employment made it possible for the owner to live according to a legitimate income from his creation.

Jim had nothing to add to his companion's lament, and left him to enter the grocery store where he traded. The merchant had heard of the wage cut and was as bitter as any of them.

Jim left the store gratified at the merchant's sympathy, and utterly unaware that he was also laboring for the storekeeper; but that while the merchant was simply catering to his wants after the employer had furnished the necessary money, the latter had actually provided the means to earn a living. It was all a matter of view point.

Jim made his way home, and with fears of the effect that the news of the cut would create, entered the bare hall of a three-family tenement. He was scarcely inside the kitchen door when a tall, slightly built youth of fifteen greeted him.

"Was made a first class Scout today, Pop!" he cried gleefully. "Passed all the tests without trouble!"

Jim made no reply, but glanced toward his wife, who was putting the noonday meal on the kitchen table.

"What's the matter?" she asked, glancing at his sober face. "You are about as sociable as a sore bear!"

"We've been cut again!" he blurted, eager to get it over with.

She was in the act of pouring out his tea. She stood regarding him with unbelieving eyes, the tea pot still held in her hand.

"We can't live on your money, now," she said, still staring at his averted face. "How much did they cut you?"

"Ten per cent," he replied.

"Do you know what that means?" she asked slowly.

"Yes," he replied. "It means that we must live off of twenty-two and a half a week."

His wife set down the tea pot, the tea unpoured, and going to the kitchen shelf, took down a small account book. While Jim watched her she jotted down a number of items, thinking long over each one. She finished, and shoved the book toward him. Then she said bitterly:

"That's what it costs us to live. Here is our living expenses under the new rate."

Jim read what she had marked down.

"Rent, twenty-five a month	$4.25 a week
Coal, one ton lasting six weeks, @ $15 a ton.....	2.50
Insurance	1.00
Store bill for five people; meat, groceries, milk, kitchen incidentals	15.00
	$22.75

"Why, we can't live on that!" said Jim slowly, with a sinking feeling at the realization. He pushed aside his plate and rising to his feet he started to pace the floor.

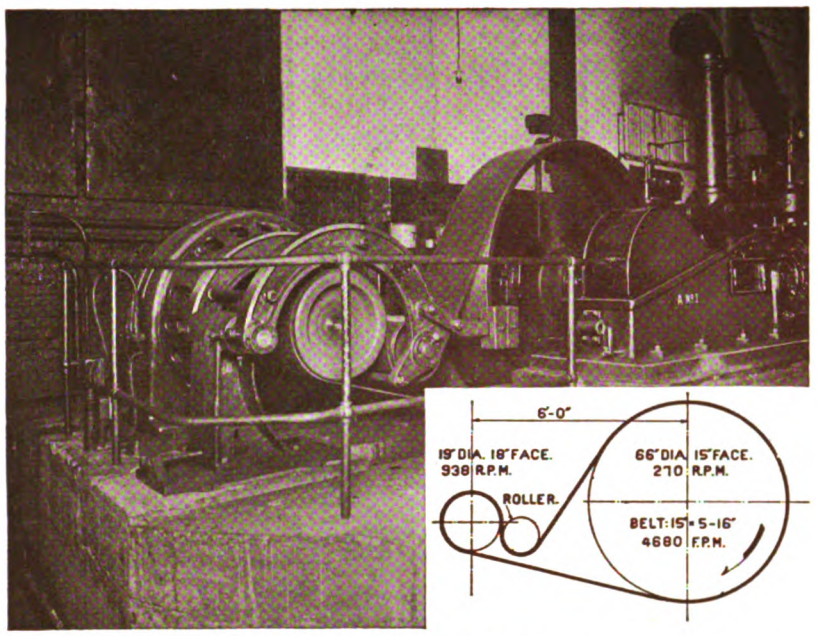
"It means," she said dully,

(*Continued on Page 38*)

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THE KORAP *LENIX

will add
MORE POWER TO YOUR DRIVE



150 H. P. Motor Driven Air Compressor.

An appreciable portion of the power transmitted by an ordinary open belt drive is wasted through belt slippage. This waste is *a real* money loss, but it is a loss that is eliminated by the KORAP-LENIX Drive,

Because

1. The KORAP-LENIX brings the larger parts of the hitherto unused surfaces of the belt and pulleys into working contact.
2. The KORAP-LENIX maintains constantly the proper tension in the slack side of the belt irrespective of atmospheric and temperature changes.
3. The KORAP-LENIX automatically follows the peaks and valleys of the load by a corresponding increase and decrease in the arc of belt and pulley contact synchronous with the variations.

Short centers, not only possible, but preferable, with the KORAP-LENIX Drive, save floor space, building space and belting.

By practically eliminating the initial tension of the belt necessary with ordinary open belt drives, the KORAP-LENIX saves in bearing friction, lubrication and renewal of bearings through the resultant minimized bearing pressure.

Less expensive, higher speed and higher efficiency motors or generators can be used with the KORAP-LENIX because of the higher pulley ratios.

The evidence is in booklet "SAVING SLIPPAGE & SPACE" which will be sent on request.

F. L. SMIDTH & CO., Engineers

50 Church Street **New York City**

* Improved LENIX Drive

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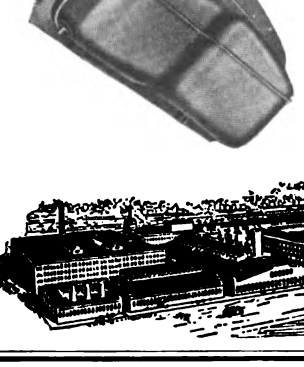
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A Specialized Service







G. P. & F. Service offers you a means of reducing the cost of your stampings and sheet metal parts, without lowering the quality of the product.

Our fifteen-acre plant and the experience of 41 years makes this service possible.

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Stamping, Forming, Drawing, Punching, Pressing and Spinning—in Steel, Copper, Aluminum, Zinc, Brass or Tin.

GEUDER, PAESCHKE & FREY CO.

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TABER-PUMPS

For Every Industrial Requirement

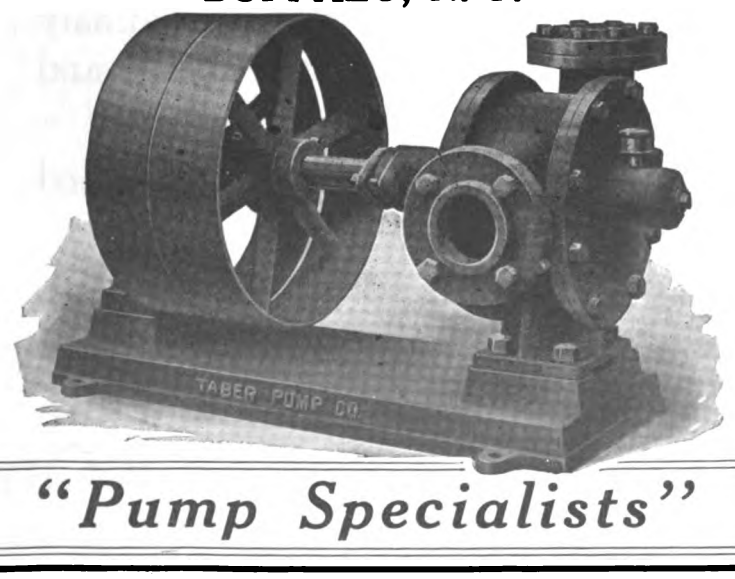
The experience of over 40 years, specializing in pumping problems for every conceivable industrial need, is at your service in the choice of the proper pump.

Our Rotory Pumps are universally used for the pumping of viscous materials such as heavy oils, tar, asphalt, molasses, etc.

We build ROTARY PUMPS with steam jackets when necessary.

Send for our booklet, which describes Taber Pumps in detail, both Rotary and Centrifugal

TABER PUMP CO., 308 Elm Street
BUFFALO, N. Y.



"Pump Specialists"

(Continued fromPage 36)

"that we have got to look for a place of four rooms instead of five. It means no new clothing, no savings, and that Bob must leave High School and help out. Oh, what's the use!" she exclaimed passionately, on the verge of angry tears. "It's always the way. Always something coming up to keep you down. If it ain't sickness, it's lack of work, or laid off, or something all the time. Now it's this cut; just when we were barely keeping even, and by going without things we need. Do you expect me to keep house, pay bills, and raise three children on that money; with living what it is?"

She sprang to her feet and dashed at her housework. Her nerves manifested themselves in her slatting the cooking utensils down; the heavy, snapping descent of her heels upon the floor, and an angry snarl at the children, who were drilling under the direction of the elder boy.

"Lots of people live on that money," said Jim weakly, inwardly cursing the Boss and the profit system. "Seems to me if we run things right we could get by."

"Get by?" she sneered. "Can you feed five people, buy all the little things you need, like soap, blacking, starch, clothes-pins, and a hundred other needs for less than fifteen dollars a week? Can you get a rent fit to live in for less than twenty-five a month; unless you want to live in a tenement in the slums? Do you want to live like that? You, who's always bragging about your forefathers fighting in the Revolution? You might, but I won't! They can cut your pay, but they don't make any effort to get living down where you can meet it. It's all right for the Boss to cut, he don't understand or care how we are going to live!"

"The bills must come down," said Jim moodily.

"Then you'd better handle the money yourself," she said. "I'm sick of the house, the struggle, and everything connected with it. Damn the shops! You stick there, taking what they're a mind to give you, and you don't know enough to get out. Other men provide for their families. You're satisfied to live like a ditch digger. I won't. Y either get another job and pr vide for your family, or I'll g out to work and let the hou go. Suit yourself!"

"What can I do?" he crie getting angry. "I work eve day there is work, and bri home my money. I don't ev keep a dollar for mysel Good God, you'd think I w doing it on purpose! I'm d ing the best I can!"

"That isn't much," she r torted. "Get out of that sh and into something else. G another job. You'll nev amount to anything there, a we'll always be living the sa way. Nothing to look forwa to but debts, poverty and bare existence!"

"It's all right to yell, g another job!'" stormed Ji seeking to defend himself anger that he did not now fe "How will I, when we owe t grocer? The rent is always week or two behind, and it co money to move. Where w we get the money to move, pa up our store bill, pay rent advance, and get settled? W can't stay even as it is."

"I don't care what you do she snapped. "Other men d What's your Unions and thing for?"

Jim did not answer. H picked up his cap and start back to work. He had pr ceeded but a short distan when he was joined by the bo Robert.

"Pop," said Bob, "you come to the Scout's meetin won't you? I'd like you t see us go through our work."

"I don't know, Bob," sa Jim shortly. "I won't mak any promises now."

"I don't understand wh other fellow's fathers g around with them,' said th youth with a sigh. "Georg Scott's father goes with hi everywhere. They go out i the car together, fishing, ba games, and everything. Yo never go anywhere."

"George Scott's father works in an office," said Jim. "He works eight hours a day and is on a salary. That's why he feels that way. H wouldn't care much about any thing, if he worked day afte day, year after year, always i debt, and always worryin about lay-offs and sickness and have hell raised with hi

(Continued on Page 40)

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Group Training For Foremen

——*Sound and Effective Methods*

DURING the past four years the Business Training Corporation has conducted *not less than 80 per cent* of all the group training for foremen carried on in the United States.

More than five hundred industrial companies have entrusted this important factor in their development to our staff.

This record is the result of a steadily growing reputation for sound and effective methods of training.

Success naturally encourages imitation—sometimes without adequate experience or facilities.

If you are interested in strengthening your supervisory force—the real underpinning of your whole organization—write today for our booklet called "Making Better Foremen." It is a practical and helpful treatment of a subject which is of vital interest to those executives who think more than thirty days ahead.

Business Training Corporation

"Greater Team Work Through Group Training."

185 Madison Avenue *New York City*

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MANAGEMENT READS RESULTS FROM THEM

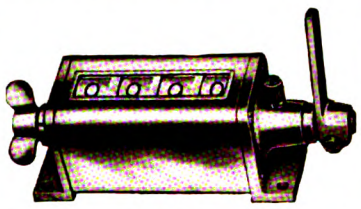
However you set about to reduce labor-costs, you must start with what the operative produces, and work toward what he *ought* to produce.

Veeder Counters tell what you're now getting, and indicate what you *ought* to be getting from the operatives at the different machines.

As automatically as they give you the records—

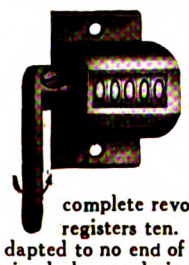
Veeder
COUNTERS

wipe out the discrepancy between the production you now get and *should* get. The worker at the Veeder-equipped machine knows "*results count*" in his production-record. Hence the record soon shows improvement!



The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list) Smaller counters at prices from $2.00 up.

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required in recording the output of small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adapted to no end of counting purposes, simply by regulating the throw of the lever. Price, $2. (*Cut ⅓ size.*) Small *Revolution* Counter, to record revolutions of shaft, also $2.



Counters for practically every type of machine are illustrated in the Veeder booklet. A copy should solve any counting problem—and it's free.

The Veeder Mfg. Co.,
63 Sargeant St., Hartford, Conn.

(Continued from Page 38)

besides about things he can't help."

Jim walked along in silence for a moment, then continued: "I'm like thousands of others with families. I've lived my life; got into the place where I'll always stay. The only thing I can do is to change jobs, and then one would be as bad as another. They're paying as much now where I am as any place. You can't make your mother see that. It wouldn't do any good to change."

The boy was thinking intently. "Well," he said finally, "it isn't enough to live off of. Ma may not know much about the different shops and what they pay, but she does know what it costs to run the house."

Jim grunted, and leaving the boy, turned toward the shop.

During the afternoon, the union man came around and informed Jim that there would be a meeting that night, open for all. He urged Jim to be present and to bring all the men he could gather.

Jim returned home that night to be greeted by a sullen, unspeaking wife. He ate a solitary supper, frowned upon by the two younger children, who seemed to side with their mother, and only an expression of would-be comradeship in the elder boy's face placed Jim as one of the clan. The harassed man finally left the house for the meeting. The logic vented there, delivered to and from the worker's viewpoint, confirmed Jim's opinion that a strike was the only cure for economic ills.

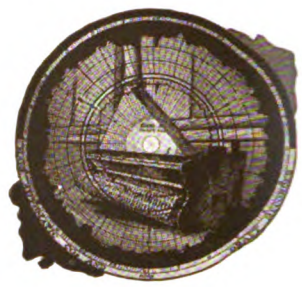
The men organized into a unit, the Union being shoved aside for the impromptu confederation. A committee was appointed. Jim was made a member.

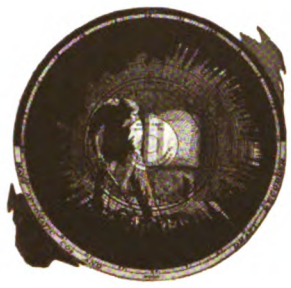
The next day the men waited upon the manufacturer. The executive, after vainly striving to interest them in his problems, was forced to fall back on the one fact he knew; either a reduction of costs or a closed shop. He stated this, and stood by the creation he had built up through long, lean years. It was too late. Nothing remained but the evident misunderstanding all around and the possible strike.

The executive called Jim to his office. The employer en-

Whether Hand Fired or Stoker Fired

You can see thru the Hays Chart







What is happening in the Boiler Room

With coal so expensive and hard to get and with freight rates so staggering it behooves every user to consume less by burning it efficiently.

To enable you to burn your fuel efficiently you must know at all times what you are doing and the reason. A daily chart from

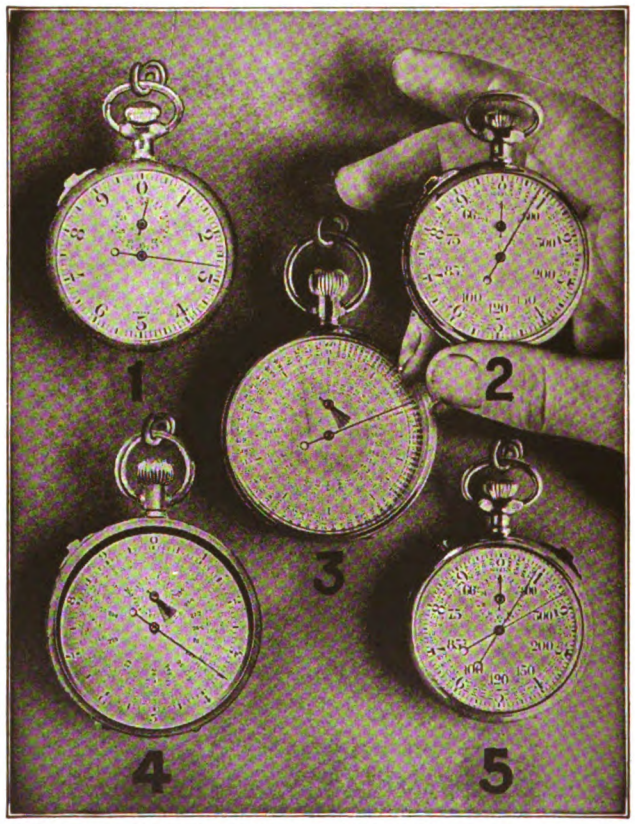
The Hays Automatic CO_2 and Draft Recorder gives you this information more accurately, and more promptly than does any other instrument.

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Literature for the Asking

The Jos. W. Hays Corporation
Combustion Efficiency Appliances
1038 E. 8th Street, Michigan City, Indiana

At Last Time Study Watches for Every Job



At last time study watches have been developed to where they can apply to every job in the plant—do their own calculating for production figures—give you direct results with absolute accuracy. Your job may be a simple time analysis—or a complex problem in piece work rate setting or a bonus system—there's a watch in this illustration that exactly fits your needs.

For Locating Wastes
Computing Costs
Setting Rates for Piece Work
Establishing Bonus Plans

You can use any one of these watches for every kind of time study. But each has special features that facilitate certain types of work. No. 1 has a plain decimal dial with the "take out time" feature. No. 2 has, in addition, direct readings in production per hour up to 1 minute jobs. No 3 carries the same readings up to 5 minute jobs, in seconds and half-seconds. No. 4 gives all readings in decimals and shows production figures up to 3 minute jobs with a special arrangement for timing jobs up to 30 minutes. No. 5 is the "split hand" watch with the "take out time" improvement which now permits careful studies of multiple operations and parts of operations. Each watch has this "take out time" feature.

Any Watch Sent on Approval to Responsible Concerns

Pick the watch that fits your job. We will gladly send it with a descriptive pamphlet on its use to any responsible concern on approval. Put it to any test you wish—prove its advantages in facilitating the work and guaranteeing absolute accuracy. Each watch is backed by our unlimited guarantee. Write us today for the instrument that fits your requirements—or in case you desire our advice, tell us the class of work you are doing and we will ship you the watch to meet your needs. No obligation. Write today for detailed pamphlets, or for pamphlet entitled "More Jobs for the Factory Stop Watch."

MORTIMER J. SILBERBERG CO.
Peoples Gas Bldg. Pioneers in Manufacture and Sale of Time Study Watches **Chicago, Illinois**

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eavored to convince the silent, itter man of the futility of ounding against him, personlly, when the world and markts were at fault. Jim listned and smiled. Back home vas a sullen and discontented vife, unpaid bills, want, disord, and lifelong worry. There was nothing for Jim to eason about. The only thing hat interested him was the ost of living and how to meet t. Let the Boss pay enough o meet this need. Simple.

"A strike means danger to nnocent people, Jim," said the xecutive. "Arrests, perhaps; lamage; loss of wages; and ossible loss of life. You now how those people act that ou are banded with. They ave no idea of American oyalty and interests."

"Well," said Jim pointedly, 'it was you that brought them n, pay them less wages than a vhite man can live from, and ire their men, women and chilren to work in the shop. You lon't see the American elenent living down in Factory listricts. When you do, you'll et what the others give you: lamage, rioting, and hardought strikes."

"But you are an American?" exclaimed the executive.

"Yep, and that's what I'm striking for," said Jim; to stay one!"

"There is no need in my talking to you," said the other sharply, "You do not understand!"

"Neither do you," retorted Jim, who felt that his job was already gone. "You only understand that our pay must be cut; but we understand that we can't live if it is. Not like decent, white men. What comes between them two points, I don't know."

"Very well," said the executive. "I'd think it over if I were you."

He dismissed Jim with a nod, and pressing a button on his desk, stared dully ahead of him.

The strike was called for the next morning. The walkout was practically complete. A few workers remained in the shops; those who for various reasons did not care to, or would not, strike.

Saturday morning found conditions about the same.

Sunday, Jim, who was still bickering with his wife over their affairs—the strike and its consequent wage loss coming as another bone of contention—decided to visit a school chum and former shop mate, who lived in a small manufacturing city some fifty miles away.

It proved a difficult task to get the money from his wife for the journey, but she, seeming to feel that it might lead to a change for the better, at last consented.

Bob saw Jim off on the trolley. The youth called out not to forget the get-together meeting for Monday night. He waved a friendly hand as the car moved away. Jim did not return the wave. His mind was on his problems. He missed the hurt look on the boy's face and the lad's sigh of unfilled comradeship.

Jim had had the foresight to send a telegram ahead, and found his friend awaiting him. "You're looking fine, Fred," he cried, as he grasped the other's firm hand.

Henley smiled. "Good living, Jim," he replied, with a keen glance.

Jim felt the look. To him, Henley represented success and peace; he, himself, discouragement and failure. Yet Henley was also a wage earner.

"What's the trouble at Watertown, Jim?" asked Henley, as they walked toward the later's cottage, showing cool and restful against its surrounding greens.

"They cut our pay ten per cent," said Jim, with quick bitterness. "The men can't live on it and they went on strike. It cuts me to twenty-two and a half a week."

"I make twenty-five here," said Henley quietly.

Jim glanced at him in surprise.

"Fact," said Henely. "It isn't what you make, it's what it costs to live. Living is pretty reasonable here."

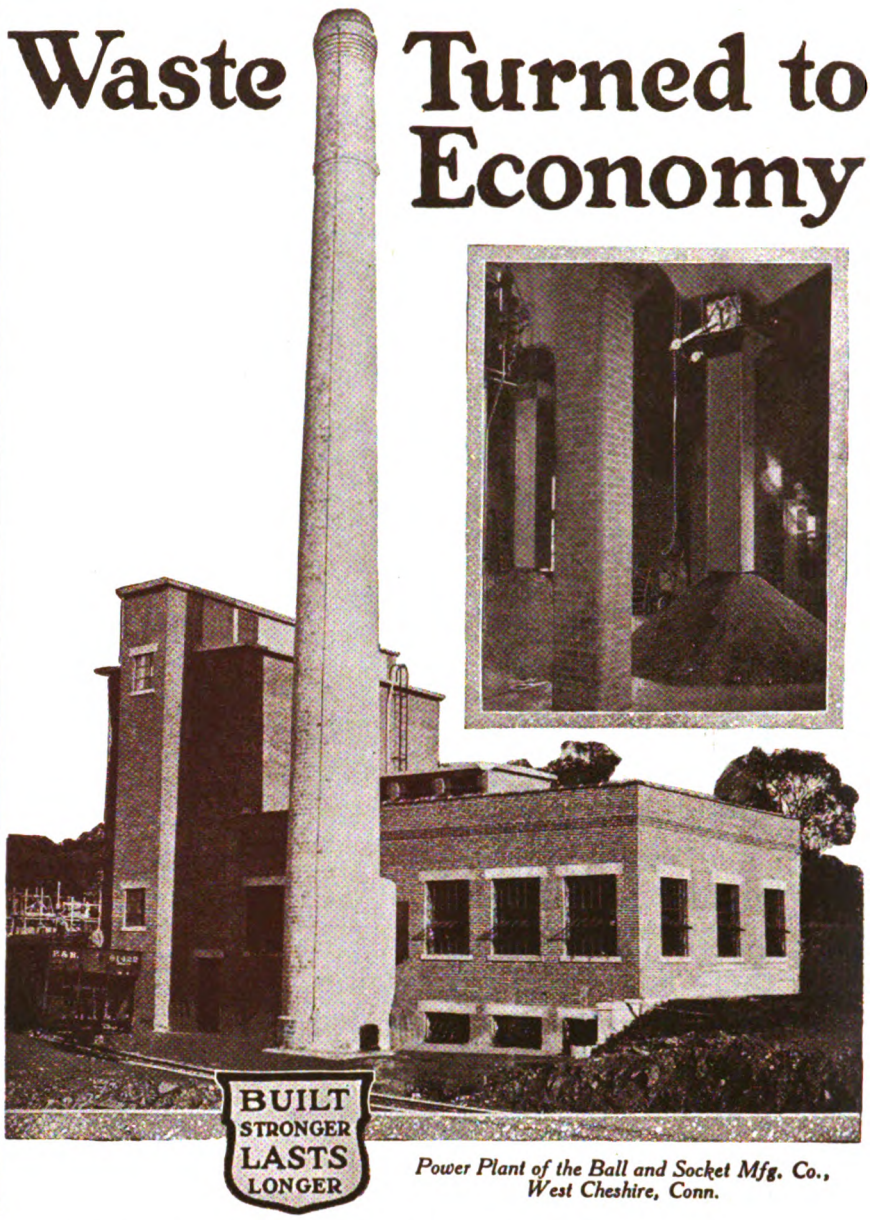
They arrived at the cottage, where Jim was greeted by a brisk, smiling housewife.

"Jim can't understand how we can live on twenty-five a week," said Henley, lightly. "He says a man and wife and three children can't do it."

"Not and live white," said Jim, ignoring the evidence before him.

"Well, we have three about the age of Jim's boys," she re-

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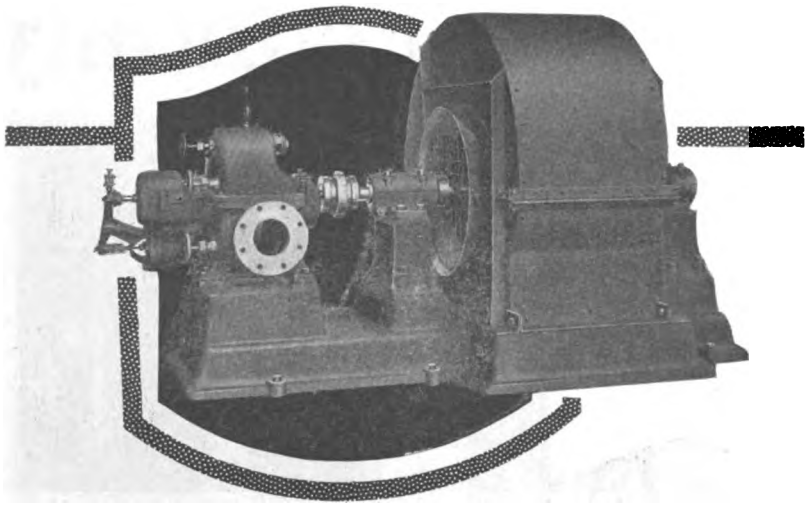
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Gifford-Wood Co.

MATERIAL HANDLING EQUIPMENT

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for Forced or Induced Draft

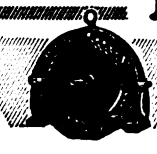


IN the selection of draft equipment it should be recalled that the most essential characteristic of the driving element is adaptability to speed regulation. When regulation is obtained by throttling the air from the fan there is a loss in efficiency which cannot be recovered. Regulation which varies the speed of the driving unit to compensate for the variety in draft requirements avoids throttling and permits higher overall efficiency. The Terry turbine has the utmost flexibility; in other words, its speed may be regulated to meet the exact requirements of the blower. When used in conjunction with mechanical stokers this speed regulating may be done automatically so that the best combustion efficiency is constantly maintained. Of the 8000 or more Terry turbines now in operation, 1800 of them are used for driving blower equipment. This is why designing and operating engineers say that because of such broad experience you cannot go wrong if for your forced or induced draft service you

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plied, "and we do it nicely. Of course, living is higher at Watertown."

They left her to prepare dinner and went out on the wide porch. Sitting in deep, comfortable chairs, Henley listened to Jim's troubles.

"It's lack of understanding on both sides, Jim," he stated, after the former had finished. "Four years ago we were in the same boat. At that time, wages were going up all over the country, ours slowly. We manufacture a line that did not fit in with war needs and business was slow. We got the men together and it developed into strike talk. There was a half-hearted attempt to meet us on the part of the manufacturers, but it got nowhere.

"Finally, one of them called in one of the leading agitators and got him talking. The worker told him a few things. Instead of hitting the shop owners he expressed his opinion of the town merchants, who were boosting up prices."

Henley paused and idly watched two youngsters race after a large rabbit, that seemed to take as much delight as the children in the merry chase.

"Well," he resumed, "that meeting and talk developed into shop councils where we men could have our say. There we heard things we never reasoned about before. Bristol, here, was a town, our birthplace in many instances, and a permanent thing. It was the town that affected us. We prospered as it did, lost as it suffered. Bristol depnded for its prosperity on the factories and the workers. There was no question about that.

"The third angle of the necessary triangle was the merchants, landlords and professional men. If doctors charged three dollars a visit, landlords thirty and thirty-five a month, and the merchants all they could grasp, then it was up to us to get more money. We figured that what affected one hit all. Let the merchant overcharge or profiteer and it meant that the manufacturer must pay more to his help. Let the shops cut below a living cost and it meant the merchant would suffer in his business. Let the workers strike, and all three lost.

"Of course, the logical thing to do would be for all three t meet in Council and work t gether. This being too se sible to grasp and follow wi out proper education, we d the next best thing. Bear mind, that this was what t Bosses were hearing from t men. We had heard th problems; namely, poor ma kets and possible shut dow unless demand could be crea and maintained by low produ tion costs and attractive s ing prices. Now, they w hearing ours.

"As a result of this clear up, the manufacturers kept close eye on the local mark Let coal get beyond the work and they bought in carload l and sold to the men. The sa with potatoes, shoes, glov clothing, groceries, and a h of other needs. This acted a brake on such as were i clined to profiteer, and h down the cost of living.

"The consequence was th the men worked for less mon than other places, but got alo better. It was a case of wo ing together, men and sh owners, with such of the me chants that had the welfare Bristol at heart also co-opera ing."

"You don't get that ba home, said Jim slowl "That's the trouble. Our p is cut, rents are high, livi stays up, and nobody, exce the man that works for a livi seems to care."

"It's simply lack of tea work," said Henley. "Yo can't expect to understand t bosses' problems by listeni to labor delegates, or he to u derstand yours by taking Chamber of Commerce reports That's what Councils are for understanding."

"No faith in them," said Jim promptly. "Another catch penny scheme of the Bosses."

"Have you, right now, an striking, any understanding your boss's problems; why h made the cut?" asked Henley

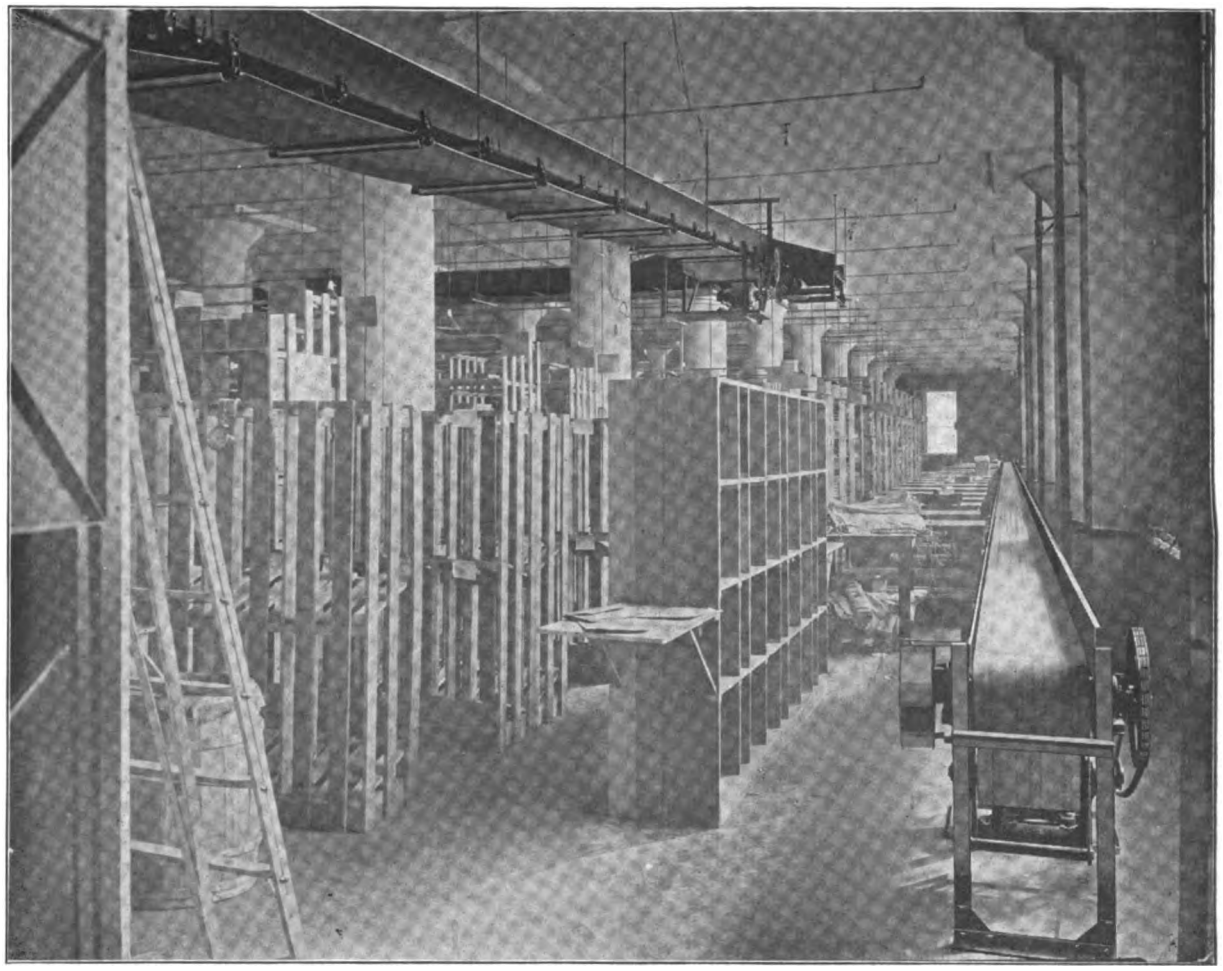
Jim had not, but he started to make a parrot-like speech about the damnable profit system.

"Neither has he of yours," said Henley, cutting short th other's flow. "If he did, he would have found some way of getting together."

"Then, there's the wife," said Jim. "She's always rais-

(Continued on Page 44)

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Showing the manner in which belt conveyors can be installed. Note the conveyors hung from ceiling as well as conveyor to the right placed on floor.

Why Did The Diamond Match Company Equip Their Plants with Conveying Systems?

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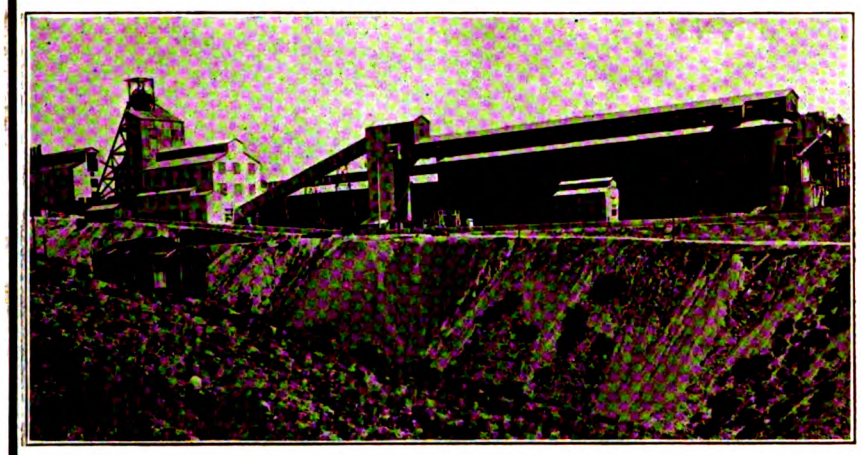
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23 Merrick Conveyor Weightometers

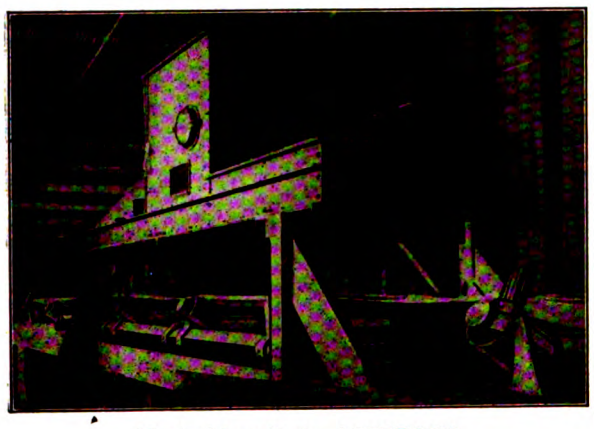
Weighing Ore while in transit over Belt Conveyor at this plant.



Inspiration Consolidated Copper Co.
Inspiration, Arizona

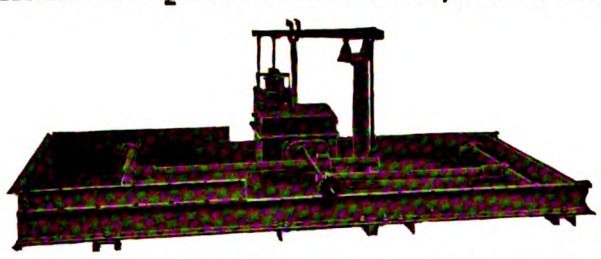
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Showing the mounting of the weighing levers with connection to the weigh beam and integrator box. Casing removed.

The WEIGHTOMETER is used by hundreds of concerns for checking incoming and outgoing weights as well as for production.

MERRICK SCALE MFG. COMPANY
186 Autumn Street, Passaic, New Jersey

(Continued from Page 42)

ing Cain the way things are going. I get sick of the whole thing. She takes it out on me for what the Boss does. I feel more like damning them than meeting them."

Henley chuckled. "I went through it," he said cheerfully. "It's simply nerves and the effect of the struggle. Have a steady job, so far as any shop job can be called steady, wages that will keep a decent home, and the right working conditions, and you will find most women are contented. I know mine is now, and we're getting along better than we ever did. She's another one of the team, either working with the Boss because home is a real home, or fighting against him when it is not."

"You might get all this in your Councils," said Jim doubtfully, "and you might get a lot of hot air that you know is Bull. How about real action?"

"I'll give you an instance how ours works," said Henley promptly. "The Kendal Company, here, had a large tract of idle land. Learning the want of the men for gardens, they staked off a big tract in plots, ploughed them at a nominal cost, and rented them to the men at a low rental.

"All the plots were grabbed at once. Any evening, or Sunday and Saturday afternoons, you could find the fellows out getting fresh air, sunshine, and working with their families. It meant health, a saving on food, and contentment.

"This same firm, seeing the need of homes for its help, gave a plot of good, high, and tillable land to such of its help who would start a home. They also held the next lot in case the home builder wanted to enlarge his holding. The latter was sold at a very reasonable sum, and many took advantage of the opportunity to get their own place."

"But that is simply because this particular firm did it," said the doubting Jim. "It's a sort of welfare scheme."

"Nix on that stuff," said Henley quickly. "We're off that stuff. We are not children for a firm to father. The manufacturers get our viewpoint and problems, and we get theirs. Understanding each other, it simply means working together for mutual help. No welfare about that. Just plain common sense and coöperation."

"It will never come in our town," said Jim hopelessly.

Henley remained silent. "How's the name-sake, Bob?" he asked suddenly. "I sure admire that lad. He is one boy to be proud of. That kid will amount to something."

"He's doing fine," said Jim, glowing. "Great kid for his age. I'll be glad when I can get to some place where we can live right. By the way, Fred, what's the chance for a job here? I'd sell off the stuff and start over if I could land something."

"No need to sell out," said Henley. "I'll lend you the money to move. I think I can manage to land you. I know that you are a good, steady worker, and we need help."

"Will this strike business hurt me here?" asked Jim anxiously.

"No, I guess not. But keep out of any mix-ups down there. Forget the strike. It leaves a bitter taste afterward."

"There will be trouble," said Jim, with a sober face. "The foreigners are mighty sore."

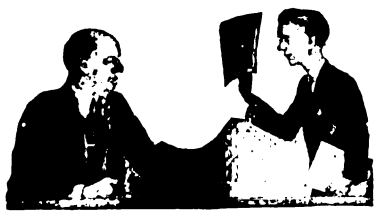
"That's the trouble," said Henley, shaking his head. "Pay below a decent living means the slums. A man will not work and go without, live in barracks, and see his kids running wild and unhealthy, and not be ready to topple over the system he thinks at fault. Here in Bristol, we are all Americans, and we are all Bristol boosters."

The call for dinner interrupted them. After dinner, Henley proposed a stroll through the town. The factories were in many instances surrounded by smooth, green lawns, and the dwellings showed the result of care and order.

"We're all gabby here," said Henley, as Jim patiently waited for the latter to finish a conversation with an acquaintance. "When you feel right with the world you don't have a chance to get moody and stick off in a corner, brooding. Between lodges, bowling, clubs, and other affairs, all of us are fans at one or the other."

Jim remained over night at Henley's. He was thinking of remaining over the day, but re-

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flected that the boy, Robert, would be disappointed if he did not appear for the meeting of fathers and sons that evening.

He arrived back in the city to find the streets leading toward his shop thronged with people. He joined them. Walking briskly, he overtook his shop-mate, the socialist.

"Well," said the latter dryly, "it's started!"

"What is it?" asked Jim, his mind back in the town he had just left; "riots?"

"Yes," said the other. "Been going it all the morning. The fools, they'll never understand! Backing up against a wall when they have the ballot. It's like all strikes. Some remain in; some go out. They go hungry for a while, then go back more bitter than when they went out. If the next day was election they would vote the same old tickets. They'll never understand until they are starved into it!"

"Yes, they will understand, too," said Jim happily. "They'll understand when they are shown. "I've been shown, Joe. I'll admit, now, the men are wrong. And the Bosses who let them go out are wrong. It's lack of understanding on both sides."

They had reached the outskirts of the mob, that had gathered before the factory gates, and endeavored to work their way into the throng. Through the crowd, Jim could make out the upper parts of a police patrol and an ambulance.

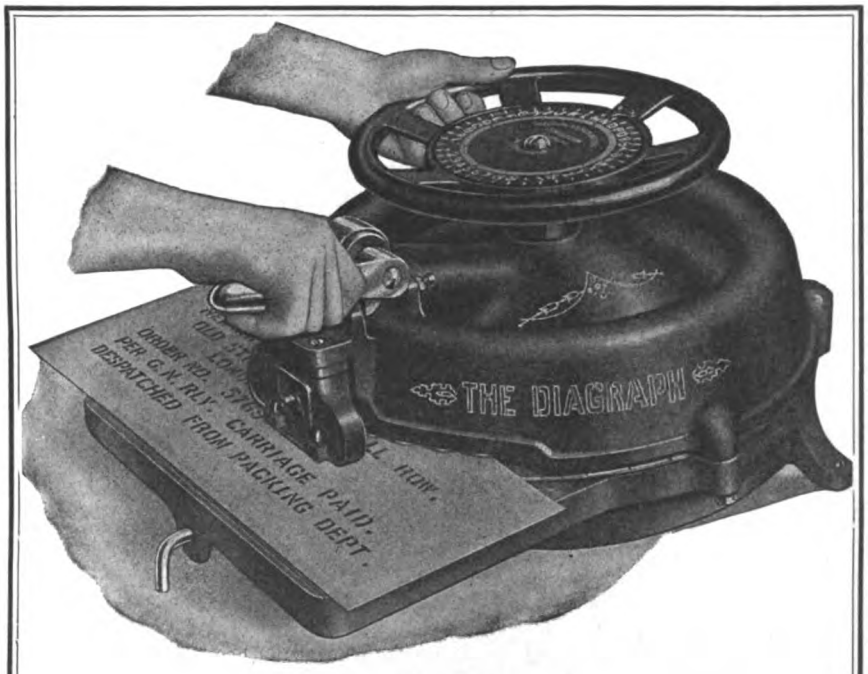
"What's the trouble?" asked the socialist of a bystander.

"Some one hit with a brick and killed," answered the one addressed, striving to force his way ahead.

Jim and his companion finally made their way through the crowd. A lane was opening before them to enable two policemen, carrying a still form, to reach the ambulance. Behind them came two more officers, dragging an ill-featured foreigner, who wore the sullen dogged look of the vindictive.

"Poor devil," said the socialist, nodding toward the battered prisoner, "he don't understand, even now, what it is all about."

But Jim, with a heart that seemed to stifle him, under-



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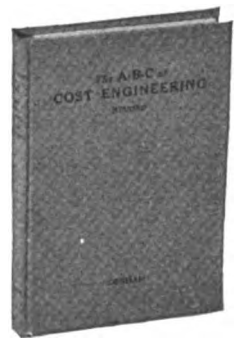
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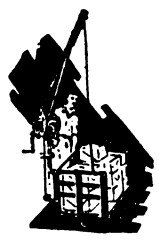


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stood.

Borne between the two policemen, their faces drawn and pale with emotion, was the limp, dead body of his boy, Bob.

Lights of the Dim Past

(Continued from Page 9)

questionable, as textiles were not yet invented. Probably the lamp burned over the whole surface, though of course some dried materials might have been added to the fat.

After the end of the cave dwelling period, thousands of years elapsed before we come to the beginning of civilization in Egypt. By that time, some six thousand years ago, the ice had receded far to the north, and Egypt had much the same climate as today. Pottery had been invented, and copper was both wrought and cast. Agriculture produced linen which was woven into textiles; the olive tree was common and its fruit was pressed for oil. All of these improvements had their influence on the lamp. It was made of pottery or copper, furnished with tow, or even a wick, and supplied with various sorts of oil.

In shape the ordinary Egyptian lamp was still much like a small cup without even a handle. At some time during the Kingdom of Memphis, however, an improvement came in by which a hollow handle was added to the bottom of the bowl, and a second bowl joined to the tube. This permitted the oil to be poured into the second bowl, and make its way to the tow of the first one even when the lamp was lighted. This form was highly useful in burning incense before the statues of the gods, and is several times pictured in the tomb paintings.

The commonest oil was probably olive, but the most highly considered was that of frankincense or myrrh, which was used in the most important religious ceremonies. This was imported from the "Land of Punt," by which was probably meant the district about the southern part of the Red Sea. The Egyptians even called Punt "God's Land" because they obtained from it the scented oils and incenses employed in their devotions.

Bitumen was known and used to some extent by the Egyptians, but whether for lighting is uncertain.

The Egyptian pictures illustrate both lamps which burn all over the surface as if they are filled with linen saturated with oil, and those in which the flame rises in a point as if it comes from a round wick.

Another lighting utensil which had come in, was the lantern. This was as yet merely a lamp which was protected by a house-like enclosure of pottery with the light showing through various openings. While colored glass was made at the time, it was used for ornaments, and is not known to have been employed for lamps or lanterns.

In addition to incense burning, lighting itself played an important part in the Egyptian religion. Hapdefae, for example, a governor in the Middle Kingdom, made contracts with the priests of Siut, to provide, among other things, for the kindling of the lights to illumine his ten funeral statues after his death, on the first and last day of each year, and at other festivals.

Herodotus, the father of history, described an Egyptian festival, in which an important feature was the illumination. As it had no doubt come down from time immemorial, his mention of the use of salt is particularly interesting, and his account worth repeating: "At Sais, when the assembly takes place for the sacrifices, there is one night on which the inhabitants all burn a multitude of lights in the open air around their houses. They use lamps which are flat saucers filled with a mixture of oil and salt, on the top of which the wick floats. These burn the whole night, and give the festival the name of 'The Feast of Lamps.'"

The Egyptians, during the

(Continued on Page 48)

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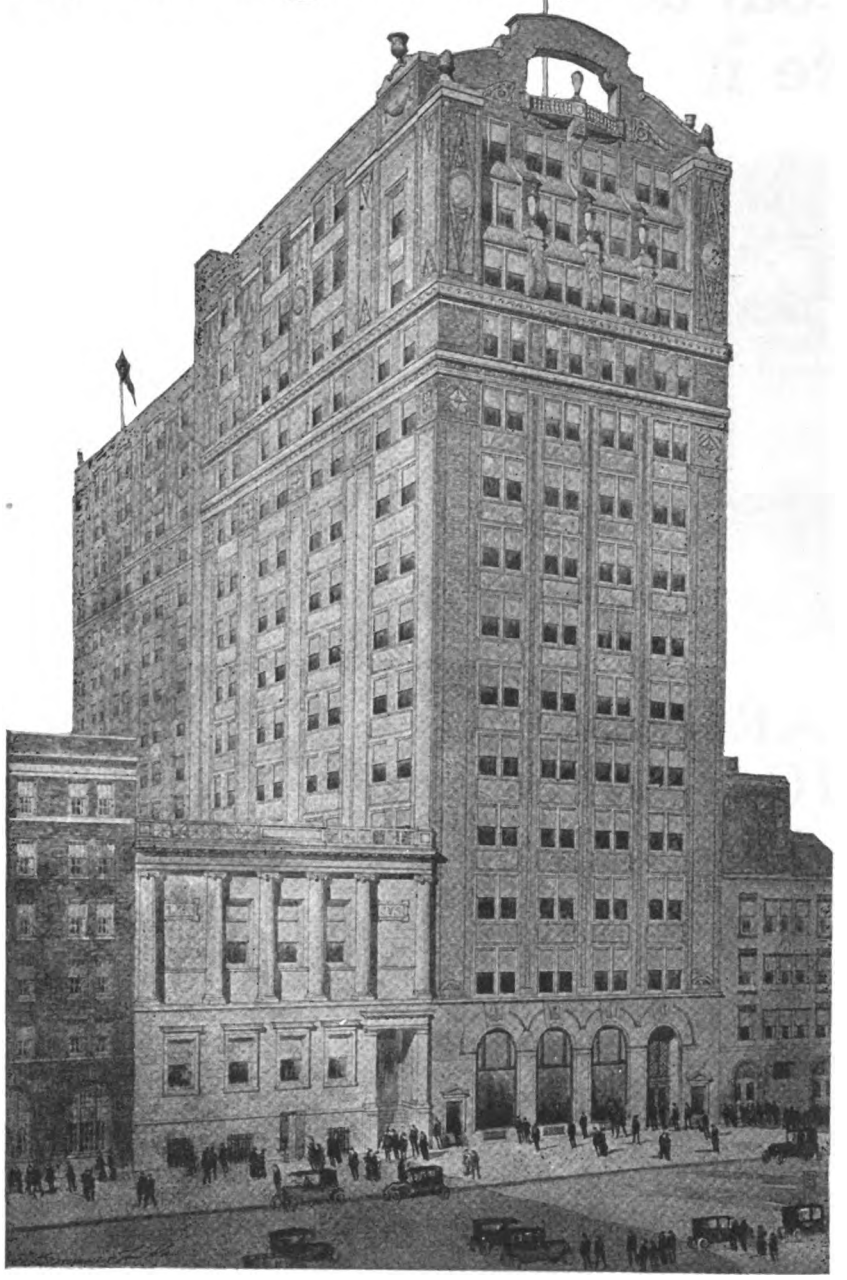
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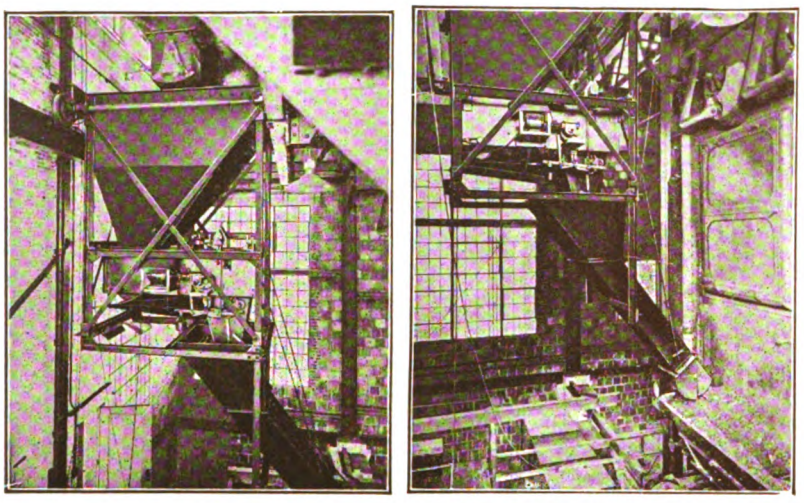
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(*Continued from Page 46*)

Theban Empire, did not know of the wax candle, and no genuine candle of any such material appears to have been invented at that time. This statement is made in spite of the fact that it is usual to speak of the seven pronged golden candle-stick of the Jews, which was used in the tabernacle.

This was actually a candelabra with seven arms, at the ends of which were seven lamps. A proof of this is the statement in the 37th chapter of Exodus: "And he made the lamps thereof, seven, and the snuffers thereof, and the snuff dishes thereof of pure gold." Again we read in Liviticus, Chapter 24, "Command the children of Israel, that they bring unto thee pure olive oil, beaten for the light, to cause a lamp to burn continually."

A representation of this candlestick, or rather candelabra, is carved on the arch of Titus, where it appears among the spoils taken by the emperor when he conquered Jerusalem.

Most of the lamps discovered in the ruins of Babylonia and Assyria were of baked clay. Some of them imitated animals which the formation of the bowl and spout suggested.

During great festivals efforts were made to light the main streets of the Eastern cities by standing on the corners huge vessels containing as much as a hundred pounds of fat, which were kept supplied and burning throughout the night.

A knowledge of petroleum, and even of natural gas had already spread over Asia Minor. This was due to the various springs of bitumen in that district, and in the case of gas, to the apparently mysterious phenomena of the Baku district. An Assyrian bas-relief of the 9th Century B. C. illustrates the defenders of a city throwing burning brands which had been soaked in oil on the heads of the besiegers.

The natural gas which issued from the ground in various places in the Baku oil fields was considered a corroboration of their religion and held sacred by the fire-worshippers. Indeed, the sacred and ever-burning fire of the temple of Baku was kept lighted until a very recent period.

Coal Buying and Burning for Industrial Power

(*Continued from Page 21*)

number of its heat units liberated through its combustion, per pound or other weight used for measure. Many engineers are quite content to report the quantity of water evaporated per pound of coal burned, this, however, being without practical value as a measure of efficiency. For example, the evaporation of eight pounds of water per pound of coal burned represents about 53% or 70% efficiency according to whether the pound of coal contains 14,000 or 11,000 BTU. It might be noted that United States coals analyzed by the Bureau of Mines show variations in BTU per pound from 6,300 and 8,400 in western lignites up to 15,000 for some of the West Virginia coals, the latter bearing more thermal units than pure carbon does.

Please do not ask the plant engineer to make coal analyses. That process is one of extreme delicacy and skill, involves the trained use of complicated and expensive instruments, and an accurate analysis of any particular fuel can be made by a central laboratory with better results and much more economically. Detailed instructions for obtaining samples for this purpose should be secured and carefully followed.

The actual cost of coal is *not its price per ton.* To the delivered price we must add unloading cost, all rehandling, transfer from storage to firebed, cost of extraction for useful work of its heat units, removal and disposal of ash, and the carrying charges on the investment in reserve supply, and space. One coal which de-

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ivers 60% efficiency through he power plant may, by reason of differences in costs, be more profitable to use than a higher priced coal which will deliver 70% efficiency.

Storage of Coal

Coal is frequent stored for reasons of supply or because of market conditions. Anthracite presents no difficulties, but the bituminous coals require much study and care. Such coals when being air-stored should be handled during the cooler hours or on cloudy days because the added heat from bright sunlight is too often sufficient to cause or expedite spontaneous combustion. After the pile is completed it will of course absorb heat during the day, but release it at night.

Some loss always occurs in stored coal because of the oxydizing of both organic and inorganic matter. Ten per cent of its heating value may be thus dissipated, and as a rule the greatest part of the loss takes place within the first two weeks of storage. Whether in covered or open storage seems to make no appreciable difference. Coals from different fields endure storage with varying losses, the western and lignites showing greater losses than eastern coals.

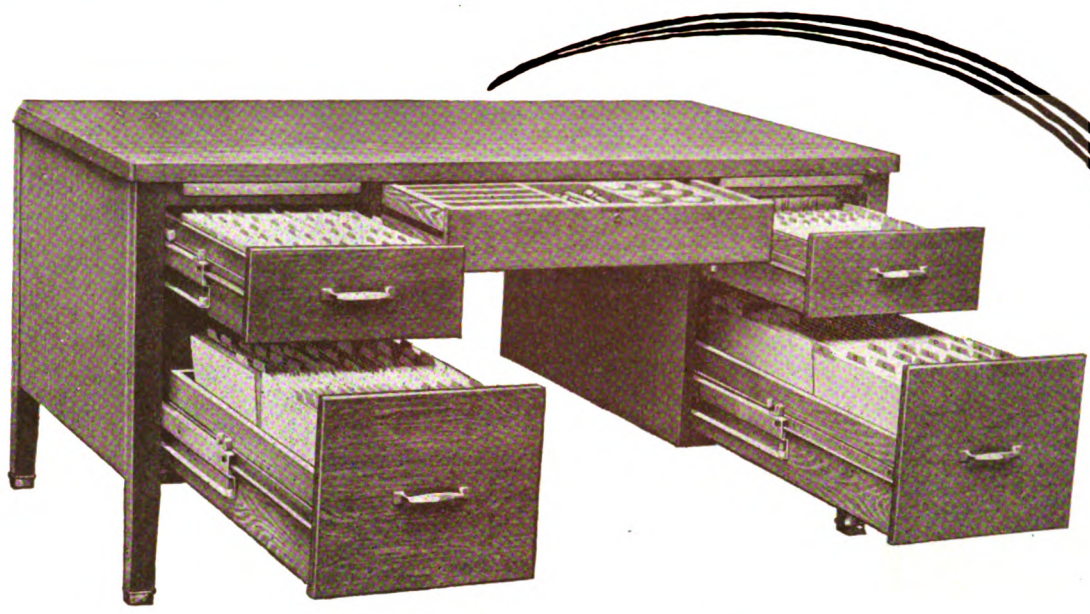
The great danger of course is from spontaneous combustion. If the coal presents large amounts of surface, as dust does, or in case dust and lumps are mixed so that the pile contains many air spaces, then such danger is increased. The cause of spontaneous combustion is oxydization in air sufficient for that process, yet not enough air being present to carry off the heat thus produced. The Bureau of Mines does not believe moisture present is a fact of importance in spontaneous combustion.

The ventilation of coal piles through pipes is always harmful. Generally speaking, it is wiser to store only coal of screened nut size. Never allow lumps to collect at the bottom, but keep the texture of the entire pile as uniform as possible, storing no coal within six weeks from the date it was mined. Pile so that no point will be more than about ten feet from an air-cooled surface. Storage of coal under water is common in some localities and has no objectionable features other than requiring wet coal to be fired.

Moisture in coal represents loss because it must be heated from room temperatures to flue gas temperatures, all at atmospheric pressure, and the heat thus used is stolen from the boiler. There are, however, some few coals in which moisture results in a mechanical action of loosening in the fuel bed owing to the steam generated, thus assisting combustion and possibly doing so to an extent sufficient to balance the heat losses, and the "wetting down" of such coal may be justified, but only when such results are *known* to be both necessary and certain. But to wet all coal as a habit or rule merely, is folly.

Combustion—Smoke and Ash

The sequence of events which take place in burning coal is in three general steps. 1. Moisture is driven off. This occurs quickly and is complete at rather low temperatures, up to



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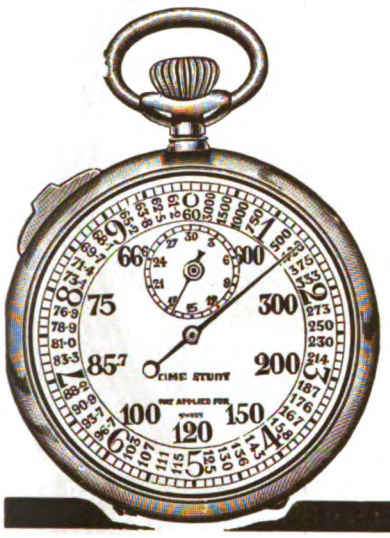


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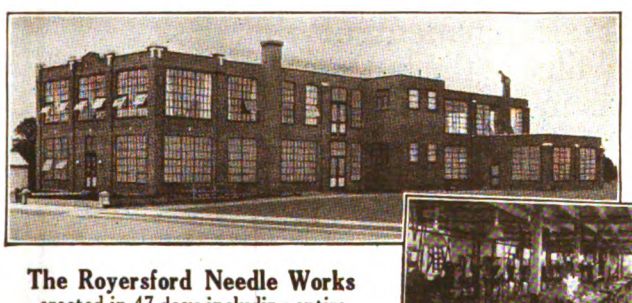
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THE SERVICE

212° F. 2. Volatiles (hydrogen, oxygen, sulphates, hydrocarbons) are distilled off by the increasing heat, but not all at the same temperature. This stage of combustion is progressive and if the temperature be high enough and oxygen present to allow it, these volatiles will burn and liberate their heat. If not, we have one principal cause of "smoke nuisance," which is also a money loss of heat units. 3. Fixed carbon has now begun to reach a stage where it ignites in the presence of admitted oxygen, and this process continues with the exposure of more carbon, elimination of the blanketing ash, and the continuation of flame. The highest temperatures are reached during this period. It also continues longest.

Smoke interests us if we are studying economy. Its presence shows that waste is going on, but it does not follow that denser smoke and greatest waste go together, nor that the emission of little or no smoke from the stacks is proof of no loss. Smoke is but one manifestation of waste. It is due to: 1. Lack of air, 2. Poor mixing of air and gases, 3. Low temperatures, 4. Too small combustion spaces, or to combinations of these factors. It is hardly safe to go further than to say the presence of smoke always indicates waste due to improper combustion, and that its presence should therefore be discouraged all possible, even though it cannot be eliminated wholly.

The residue after combustion is important as a problem in disposal. It constitutes ash, composed of all the non-combustible part of the original coal, plus what unburned portions the grate or firing methods allow to escape. Ash is a residue mixture of silicates, sulphates and oxides—the former largely predominating. When melted, it forms clinker or slag, but as all ash does not fuse at a fixed temperature we may assume in case of having much trouble with clinker that our particular ash has a low fusion point, probably under 2500° F.

A singular and not widely appreciated point regarding the fusion of ash should be noted. The same ash will become viscous and adhere at



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has no terrors for "Pennsylvania" Coal Preparation Machinery, which has been specialized to pick out Tramp Iron automatically, or pass it without damage.

"Pennsylvania" Bradford Breakers, for large Central Stations, Mines and Gas Works, with almost human precision throw out tramp iron, rock, bone and sulphur balls without damage to the machine and without power, labor or supervision.

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OurEngineers study the requirements in each case and suggest the size and type of apparatus specialized to insure a continuous supply of properly prepared coal at minimum cost per ton for Central Stations, Gas Works, By-Product Coke Plants, Industrial Power Plants, Gas Producer Plants and Coal Mines.

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different temperatures, depending on whether its enveloping atmosphere is an "oxydizing" or a "reducing" one. An oxydizing atmosphere exists where oxygen is being withdrawn from the air to unite with the carbon, while in a reducing atmosphere we are actually withdrawing oxygen from the combustion products, changing our CO_2 gases back to CO.

Oxydizing conditions obtain in the lower portions of the fuel bed, while reducing stages occur in the upper layers. Ash in an oxydizing atmosphere has a higher melting point by differences of between 120-260° F. Possibly this will explain how a combustion engineer will cure a furnace of its troublesome tendency to "paste up" bridge walls and arches, merely by proper admission of more air above the fuel bed. He thus changes the incorrect and harmful reducing stage to that of more complete and desirable, as well as profitable, oxydizing, and saves the heat losses while stopping injury from slag.

Ash reduces efficiency with its increase in percentage present because of resisting the contact of air with the fuel, requiring greater draft, lowering the proportionate heating value of the coal because of ash-content per ton, and lastly on account of the additional time and cost required for ash disposal. Ordinary coals usually contain between four and twenty-five per cent ash.

In planning ash pits and disposal equipment provision should be made for about the following percentages of ash refuse in cases of the coals named:

High grade seaboard	10%
Pittsburgh	15%
Illinois and Indiana	20%
Iowa and Southwestern	40%

The manner of handling the fuel bed may be easily responsible for much trouble with large clinker because ash which drifts down on the grates will not fuse there, while if it be lifted into the higher temperatures in the burning area of the fuel above, it will melt, run down, cool and harden, then appearing as cakes which reduce the firing area and ability of the grate. Therefore, excessive working or slicing of the fuel bed usually magnifies trouble with clinkers instead of curing it, as intended. Improvement comes from a better disposal of the ash without such disturbance as will mix and flux it. Side motion or twisting of slice bar is a protection against much clinkering, as likewise rocking or shaking grates may be.

While bad firing methods may hasten and increase the slagging of ash, its primary cause is fusing because of the silicates of the ash combining with other ash content which will lower its fusing point, or the improper creation of reducing instead of oxydizing temperatures in the fuel bed, which result in melting tendencies as explained. Therefore an exact knowledge of the constitutents of whatever coal the plant uses is of great value. This analysis sometimes results in an advantageous change being made in the type of grates installed, in order that the cheapest or most easily obtained fuel may be best handled.

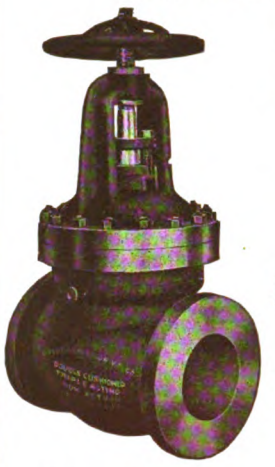
Admitting, however, that delivery costs and matters of supply usually govern what fuel is available in average cases, rather than ideals or theories, then furnace equipment should be installed which is best suited to that supply. In any case, economy noticeably follows the correct relation between furnace equipment and the fuel used.

A few general rules may be applied. For example, if the coal to be used is rich in volatiles then a large combustion chamber and long flame travel must be arranged. The "Dutch oven" type of firebox has advantages in burning such coals, but care must be taken to set the overhead tiles far enough back so their reflecting heat shall not produce distillation of the freshly supplied fuel too rapidly. Overlooking this rule, particularly in hand-fired furnaces, make many a smoky stack.

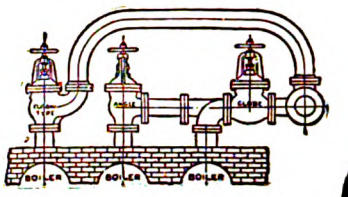
Arches and mixing pillars assist materially in properly handling richly volatile fuels. Large combustion spaces are of vital importance, and if so built as to cause changes in direction of gas travel, more intimate mixing is accomplished and this affords a more effective and efficient method

GOLDEN-ANDERSON Pat.

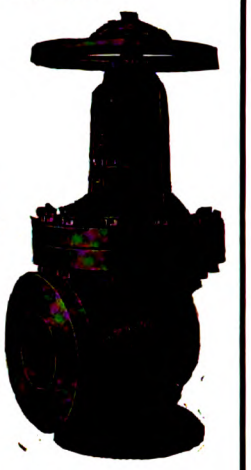
"Life and Property Insurance Valves"



Golden - Anderson Patent Automatic Double-Cushioned Triple Acting and Non-Return Valves



"No Shut Down When a Boiler Tube Bursts"

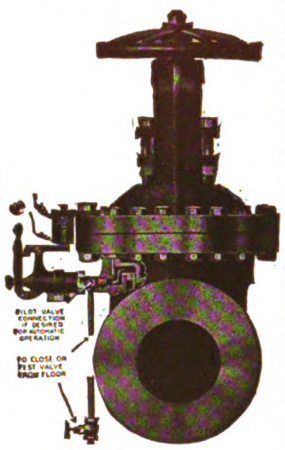


Triple Acting Style Globe Pattern

Plain Non-Return Style Angle Pattern

1—Prevent complete shutdowns in case of accident in any one of the boilers by isolating it from the line.
2—The triple acting style also shuts off the steam flow from all boilers when a steam pipe ruptures.
3—Automatically equalize the pressure, and prevent backflow of steam into a cold boiler.
4—Double-Cushioned in opening and closing by Corliss Dashpot. No pounding, chattering or sticking.
5—The only valves that can be tested in service from the boiler room floor.
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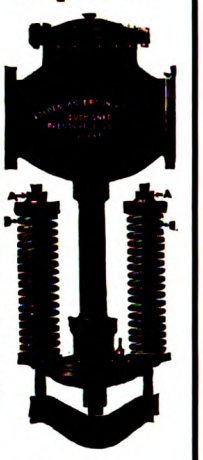
Give perfect automatic control of the steam or air flow in any pipe line from one or more distant points.
Can be opened or closed instantly in case of emergency by steam or electricity.
May be tested while in service, giving complete assurance of safety.
Positively cushioned by double Corliss Dash Pot. No banging, sticking or chattering.
Contain no springs or tight-fitting parts.
Can be adapted for automatic closure in case steam pipe bursts.
Double extra heavy and virtually indestructible.

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Automatically hold the reduced steam pressure constant.

Fitted with patent safety piston that prevents high pressure escaping to low pressure side.



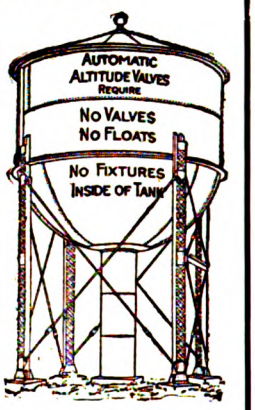
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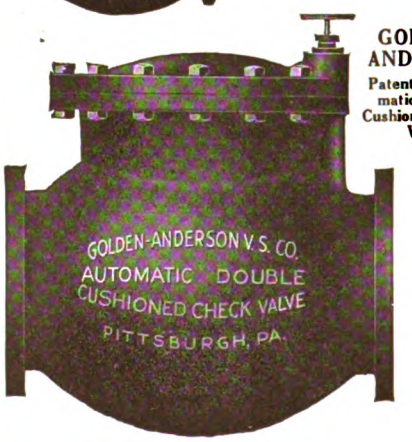
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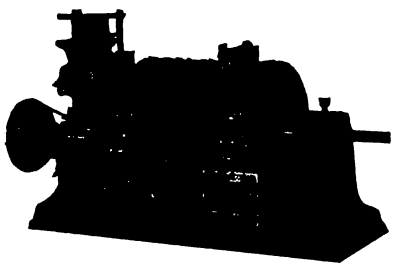
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Pulverized Coal



The Aero Unit System

of Pulverized Coal again demonstrates, as in other work of human endeavor, how an original idea at first worked out by complicated and costly methods is finally simplified and perfected until it becomes a part of our every day existence.

The Unit System reduces the equipment and therefore the cost to a minimum by placing the Aero Pulverizer at the furnace where the coal is fed to the machine undried and is exhausted therefrom directly into the furnace. There are no dryers, no storage or long lines of transportation for the powdered coal, thus eliminating the hazard of fire or explosion.

Each Aero Pulverizer is designed as a complete powdered fuel unit for one furnace. They are built in standard sizes ranging from 600 lbs. to 5000 lbs. of coal per hour.

Bulletin Sent on Request

AERO PULVERIZER COMPANY

165 Broadway New York

than pillars and arches alone do.

Steam publishes the following general classification of coals by percentages of carbon and volatile content:

	% fixed carbon	% volatiles
Eastern bituminous—	60-75	25-40
Western bituminous—	50-65	35-50

As a rule, high volatile coals do not give as good results as those bearing larger proportions of fixed carbon. Little difficulty is met in burning coals of low volatile content, therefore less skill and attention are needed, simpler apparatus may be installed and yet as good or better results obtained, on the average.

Broadly descriptive, it may be said the central-west bituminous coals are of a free burning type with high ash content. It is rather well settled that such coals are handled to advantage with chain grates, which are not, however, well suited to coals inclined to coke and carrying low percentages of ash-characteristics of coals from eastern fields.

The size and style of grate surfaces must be selected with reference to the fuel used. Plain bars are adapted to large size lumps, and the herringbone or drilled types serve best with fine coal. If the coal has a high ash content, much saving can be made through the use of shaking or dumping grates. Chain grates as used in many stoker equipments are not commonly well suited to coals of small ash content, but will handle well a free-burning coal of high ash proportions.

It may be noted that if the coal to be used is lignite, subbituminous, semi-anthracite or fine-sized anthracite, then natural draft must often be replaced by mechanical or forced draft because the height of stack called for to maintain the necessary natural draft will be found prohibitive. All large sized coals may be burned with lower draft pressure.

Also if the steam plant supplies a dye works, distillery, laundry, or other industry which similarly requires very wide fluctuations in the amounts of steam called for, and the times of delivery of such amounts, it will be found well worth the trouble and extra expense, if any, to provide a coal for fuel whose ash has a high fusion point.

Hand-fired Boilers

If our boilers are hand fired, let us completely destroy (not merely lay aside) the ash pit doors before another day passes. There is ordinarily no more costly proceeding on the fireman's part than the closing of these doors, with the consequent stopping all entry of air below the grates.

Whenever checking of the rate of combustion is demanded it should be made possible only by closing the stack or breeching damper. If gases are prevented from escaping at the outlet, air cannot enter, and this is the only correct theory of checking. Closing of ash pit doors invariably heats the grates and weakens them, forms slag or clinker with the stoppage of air, causing repair and replacement expense which is wholly needless.

Another bad result is that increased pressure is thrown on every air duct or leak into the boiler setting when ash pit doors are closed, resulting in the increase of cold excess air with its damage to boiler shell and loss of heat through lowering of temperatures.

In hand fired boilers the Bureau of Mines has tested out the two methods of firing commonly used. One is the spreading method wherein small amounts of coal are cast on the fire either in "strips" or over the entire grate area. The conclusion stated is that this method gives higher CO_2, lower temperatures in gases leaving the boiler, greater uniformity in furnace temperatures, and better over-all furnace efficiency.

The other or coking method requires fresh coal in larger amounts to be fired near the doors, and when coked, to be pushed further back, progressively. Where the furnace design is such as to pass the gases horizontally to the rear over the fire bed and thus permit the flaming area to force combustion of the volatiles from the coking coal, then this system of firing is applicable—otherwise not. The coking method can be used only with a rather steady steam demand and does not lend itself well to handling of a fluctuating load. Ordinarily this method is productive of less smoke, but be-

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ause of the necessary exposure of large areas of the grate while moving the fuel bed sectionally to the rear, as described, large losses are bound to occur from excess air entering.

Any hand firing is hard physical labor, yet requires skill and care. The man who is clever enough to give this subject the proper study usually promotes himself out of the fireman's job. Right here the engineer should provide for a record of flue gas analysis from which he can identify the unguarded and unguessed wastes always present, and improve firing conditions and methods by knowing exactly what is needed.

In any event, light and frequent firing should be done. This insures the fuel supplied bearing a better relation to the usually constant air supply we find in hand-fired plants, likewise tending to prevent thin spots occurring in the fire and burning through, to admit excess air.

Ideal conditions call for the admission of larger quantities of air over the fire immediately after throwing on fresh coal, so the prompt combustion of the distilled volatiles may be correctly accomplished. Then this excess air supply should be cut down by steps. It is readily seen how impossible is the giving of such care on the part of the average fireman, this fault being nevertheless a very substantial factor in the constant waste of fuel. The method of lighter and more frequent firing is therefore seen to be the more practical and efficient, in a general sense, and considering conditions broadly as we are apt to find them in the average furnace room.

Stoker Firing

As to stokers, there are three general types, the chain or traveling grate, underfeed types and overfeed types. All provide for the coking or progressive method of firing, subjecting the coal to distillation at a constantly increasing rate until it reaches the fire zone and is there consumed.

Stokers of most types are and can be operated with natural draft. However, those stokers intended for burning fine sizes of coals are necessarily equipped with forced draft devices, feeding air under whatever pressure may be needed. Forced draft is often arranged for in order to drive boilers at an over-rating.

All styles are power driven. The fuel is fed from hopper supply at rates which can be governed. The speed of travel of the fuel bed can be regulated. Thus it is possible to feed fuel at whatever rate will insure its complete burning by the time the discharge point has been reached, without carrying unburned portions over into the ash pit. Likewise the rate of combustion and amount of coal burned can be adjusted in accord with the demand for steam, more closely than with hand firing. The operator need attend but one or two adjustments without extra labor, to vary his steam output.

Stokers allow larger amounts of fuel to be handled at lower costs, permit boiler capacities to be attained or exceeded with greater ease and the certainty of uniform results, and, when used, the engineer is able to establish a closer system of economical combustion, as a rule.

The stoker alone does not solve the problems of best efficiency and economy. Any method of firing steam boilers to the best advantage requires understanding of the subject of combustion, care and study in application, proper instruments for study of boiler and furnace conditions, all so that *facts* can be known and not guessed at. Some of the practical angles of this subject of correct operation, when presented, will help the plant executive to a working understanding of what can be and is being done in this department toward an appreciable saving in fuel and operating costs.

It is far from being a difficult subject. It is merely not widely and thoroughly understood as yet.

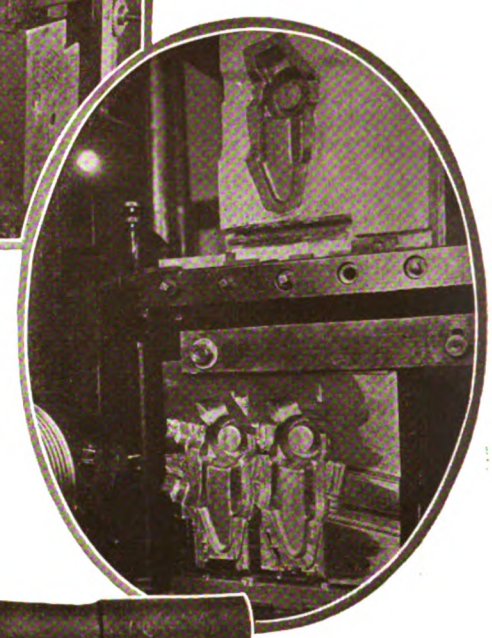
Do It Mechanically —by the Keller Method

A few illustrations showing how the *drop forger* is doing it. Modern efficiency makes hand methods obsolete.

KYE



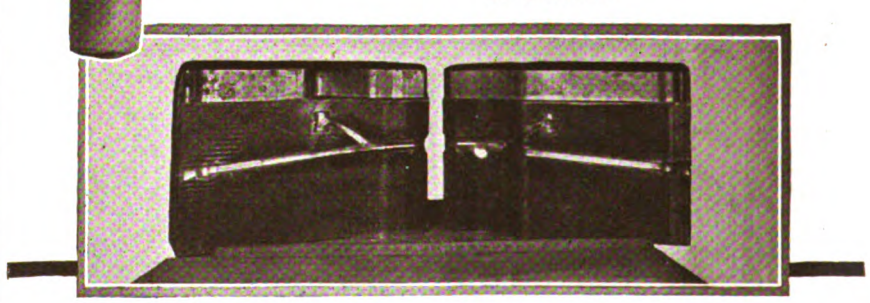
A large wrench manufacturer is cutting dies like these on a Keller Automatic Machine in eight hours.



Intricate locks and deep cutting present no difficulty to a Keller Machine. Note how it has reproduced in steel two impressions with locks and all, from a plaster pattern—working *automatically.*



Ford Steering Knuckle—the dies are cut automatically in 13 hours.



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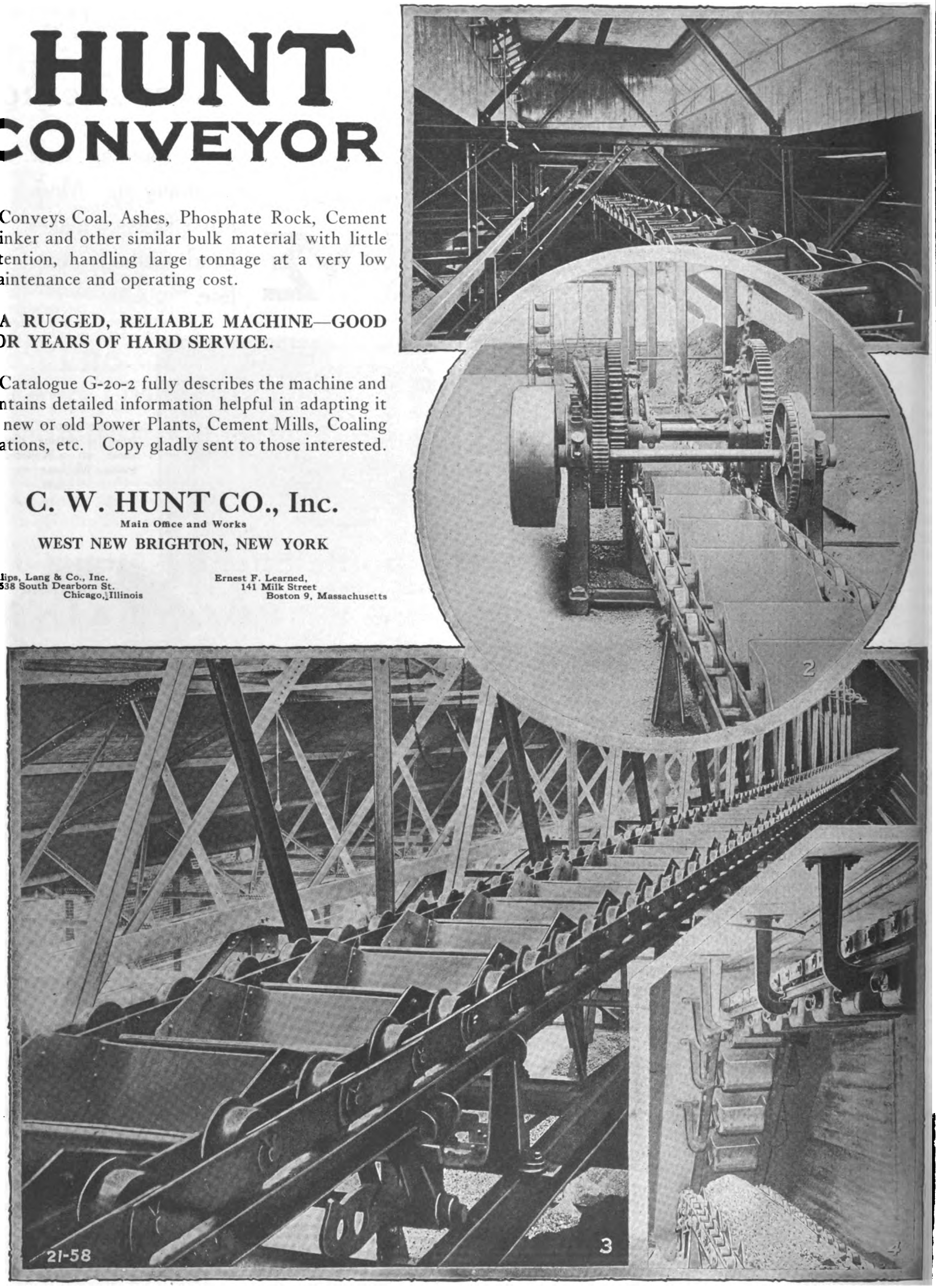
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1. Pivoted bucket conveyor with cast iron buckets.
2. Hunt Pawl Driver which insures an even pull on conveyor chain at all times.
3. Conveyor with sheet steel buckets for handling coal installed in large Pumping Station.
4. Upper and lower run of conveyor with sheet steel buckets showing one of the many methods of supporting conveyor.

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The Future of Electrical Engineering

(*Continued from Page 23*)

water. A water power operating by itself is obviously limited in its capacity to the smallest stream flow of the year. By inter-connecting a number of water powers this disadvantage becomes much less since the periods of low water will not in general coincide. Further temporary reserve power will be afforded by steam stations connected to the same system. Where it is practicable to do so the steam generating stations feeding into such a system will unquestionably be located at the mine mouths, thus avoiding the transporting of coal over long distances and relieving to a large extent the load upon our railroads. It is unfortunately impracticable in many cases to do this since frequently a sufficient supply of water for condensing the steam is not available. The development above indicated is going on day by day and is only a question of time until the greater portion of our power will be generated and transmitted in this way.

Railway Electrification

One of the great needs of today is the further electrification of railroads. The steam locomotive, as we know it today, is a magnificant piece of work, but it apparently has reached nearly the limit of its development, both in power and in economy. A pound of coal burned in a first class modern plant will do from three to five times as much work as a pound of coal burned in the best locomotive. If we are to conserve our coal resources [illegible] obviously one of the first pla[illegible] to sta[illegible] with the steam [illegible] not[illegible] the f[illegible] [illegible]

cation will greatly increase the capacity of our railroads and will of course tend to relieve freight congestion. The great thing standing in the way of the electrification of the railroads today is the lack of available money to make the change. No one doubts that the saving would easily pay for the cost of the change in many cases, but if the railroads have not the ready cash they are helpless. This is a condition which we hope to see improved in the near future.

The creation of the super power system mentioned above will obviously assist greatly in electrification of the railroads. If the railroad is paralleled by a transmission line it will obviously be much easier in most cases for it to purchase its power than to build power plants and transmission lines of its own. Not only will the initial investment be much less, but probably the power can be supplied at a lower rate than the railroad could generate it for itself.

Electrical Heating

It will unquestionably occur to many people that with a power system as above outlined, electric heating of homes would become practicable. This, however, is one of the things which is apparently hopeless. Even our best power stations waste far more of the heat of the coal than they are able to use. It is obviously impossible to generate power, wasting in the process three-fourths of the heat value of the coal, transmit it over long dis[illegible] at a heavy expense for [illegible]ors and waste still [illegible]e way and then use [illegible]r heating in such [illegible]apete with coal. [illegible]le price for [illegible]n see now, [illegible] man's [illegible] for [illegible]ed

Stop the Time Waste on Drinks



How much time do your men spend each day going for drink? If they must seek a distant hydrant, five minutes is a conservative estimate. That amounts to twenty-five hours annually. Multiply this by the number of men in your employ—doesn't the tremendous time loss convince you that convenient drinking equipment will save money in your plant? R&S fountains can be placed anywhere — there's a style that fits conditions in your factory. And they are thoroughly sanitary. *Lips cannot touch the mouthpiece*—contaminating germs cannot fall back into the jet. Scores of big and little concerns are saving hundreds of dollars annually with these fountains. Write today for complete catalog and free information.

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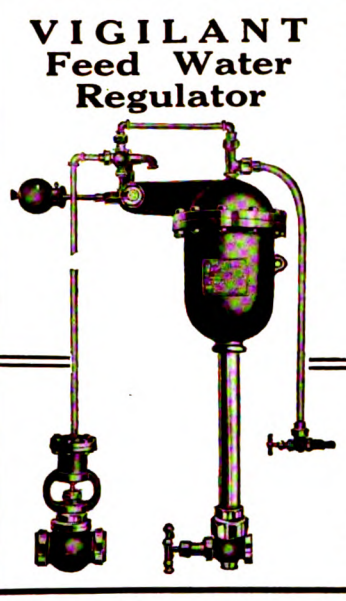
Boiler Room Economy —a fact

NO boiler room can be run efficiently if the regulation of the feed water is left entirely to the human element.

The water level should be kept constantly at the proper point in order to be assured that coal is not wasted unnecessarily.

The VIGILANT Feed Water Regulator, the premier regulator in the field, has been giving steady reliable service for over 25 years. It holds the water level to a given point. There are no complicated parts to adjust or get out of order. It cannot fail to operate because it depends on gravity for its action. It is an absolute safeguard against explosions because low water is impossible with the VIGILANT.

VIGILANT Feed Water Regulator

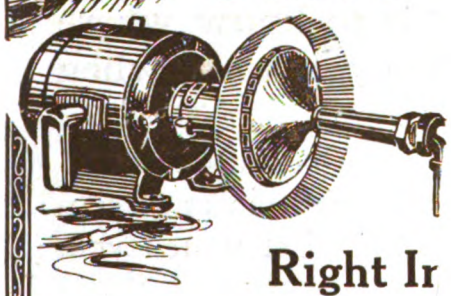


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with rate of flow, tempera
perfect control if you equ
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This wonderfully efficient unit suppli
constant volume of pure air, regardles
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room temperature practically uni
whether outside temperatures are 4
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Send for free book on air washin and conditioning today.

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Milwaukee, Wis.

clearly an increasing use of electric heating in the various industries, for example, in the production of fine steels, in heating electric ovens and other places where localized clean heat is necessary. In fact this phase of the utilization of electricity has already assumed tremendous importance. Electric cooking falls in this catagory and there is little doubt but that it will be extensively used in the future. The cost will probably always be a little greater than the cost of cooking by gas, but convenience and cleanliness will in many cases compensate for this small additional cost.

The electrified ship, as far as battle ships are concerned, has already become the standard and there is considerable reason to believe that electric propulsion will be used extensively for other large ships. It is, of course necessary to generate the power by means of an electric generator driven by a steam turbine and conduct it by means of cables to the motor which drives the propeller. There are certain technical advantages in doing this rather than driving the propeller direct by the steam turbine but a full discussion of this would be out of place here.

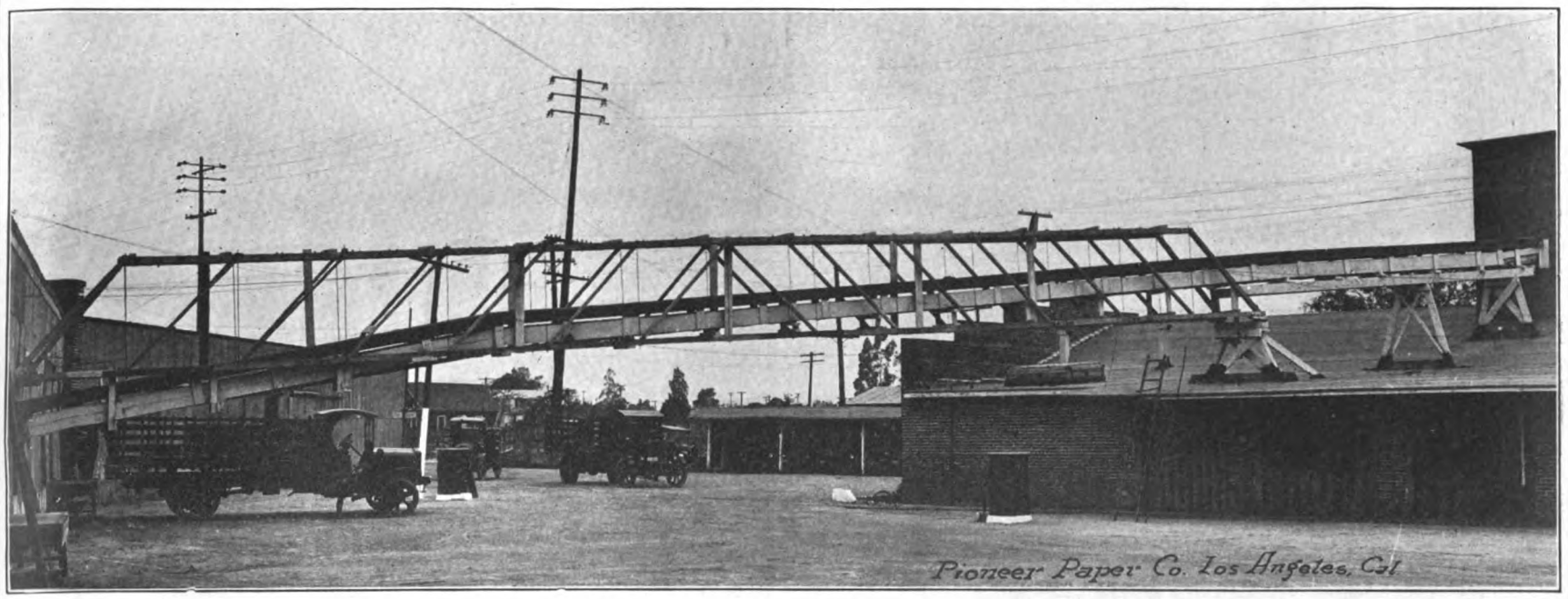
All the above extensions of the use of electricity are in my opinion clearly in sight. In addition electrical engineers have their dreams which they would like to see come true and some of which may some day be realized. One dream is the light storage battery. It is unfortunate ... to store ... he ... rds ... ch ... e ... at- ... ind of a motor which could ... rated by the current ... om electric ... less tran... ream ...

of car would weigh only a few pounds. Were some inventor to produce a battery capable of storing somewhere near the same energy per pound of weight as we can now store in coal or gasoline, there is no question but that the gasoline automobile would disappear almost over night and we could substitute for it the comparatively simple, cheap and noiseless electric automobile. It is hardly necessary to add that no such battery is in sight, but it is a pleasant dream that we may indulge ourselves in when we have nothing better to do.

The direct production of electric power from coal without the interposition of boiler, steam engine and electric generator is another favorite dream. If this can ever be carried out it will work an industrial revolution greater perhaps than any we have ever seen. Numerous attempts have been made along this line, but the indications of complete success are very faint.

The wireless transmission of power is a favorite theme with our newspapers. Apparently there is no inherent reason why this could not be carried out provided it were done on a large enough scale; namely by one unified system supplying the entire world with power. No method has ever been worked out of directing wireless waves with any great degree of accuracy. Anyone who wishes can erect an aerial and tap into any of the waves that happen to be going by. This is one of the obstacles in the way of the wireless telephone as a universal means of communication since so far no means has been found of directing the waves enough to make communications secret. Besides this difficulty there is not, at present, in sight any

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"It's a Mathews."

Saves Forty Dollars per Day

THE PIONEER PAPER CO., Los Angeles, is doing this with a Mathews Gravity Conveying System.

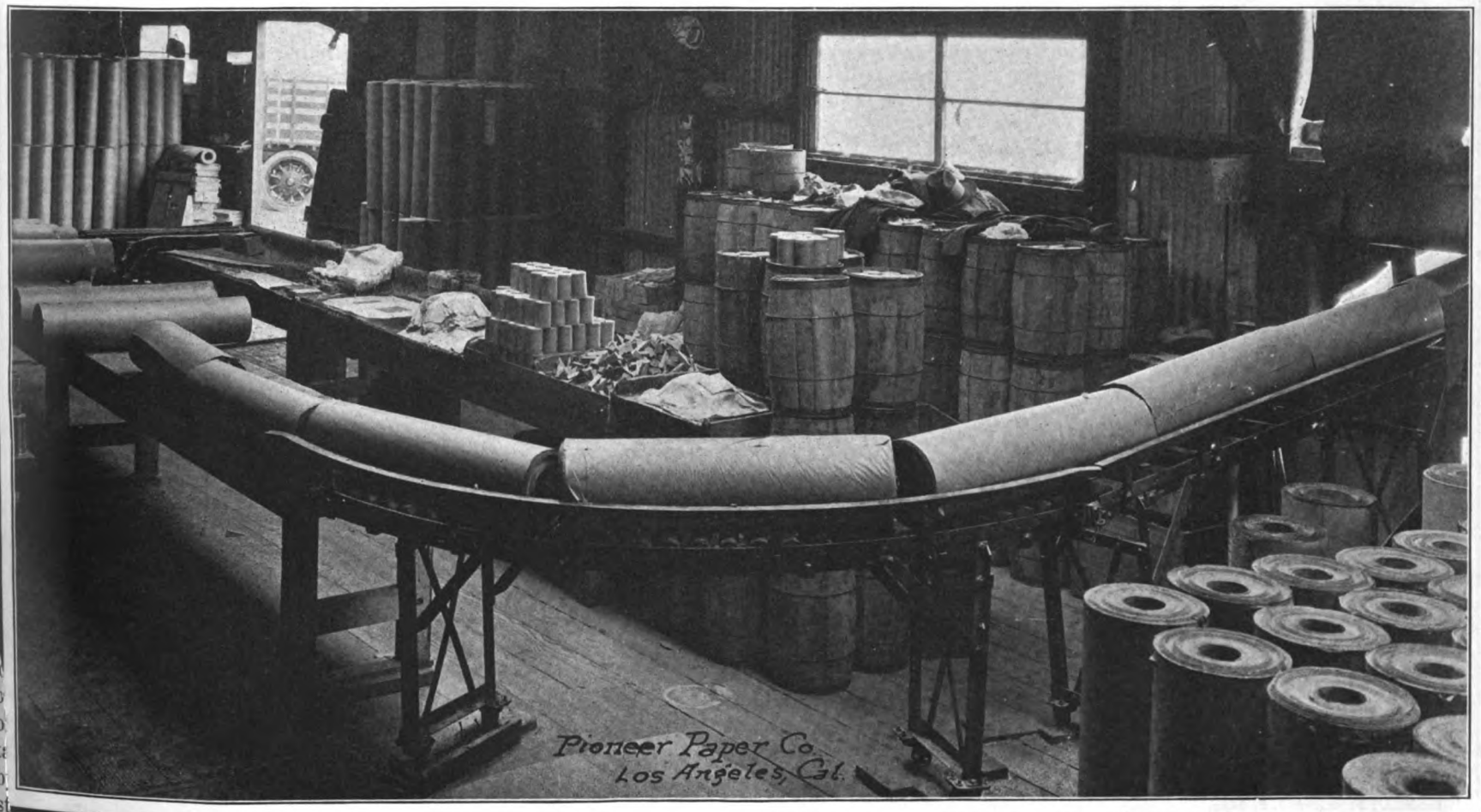
Rolls of Roofing Paper are delivered by gravity from one building to another, over a bridge with a clear span of ninety feet as fast as ten men can handle them at the finishing bench. The work was formerly done with industrial track and truck system.

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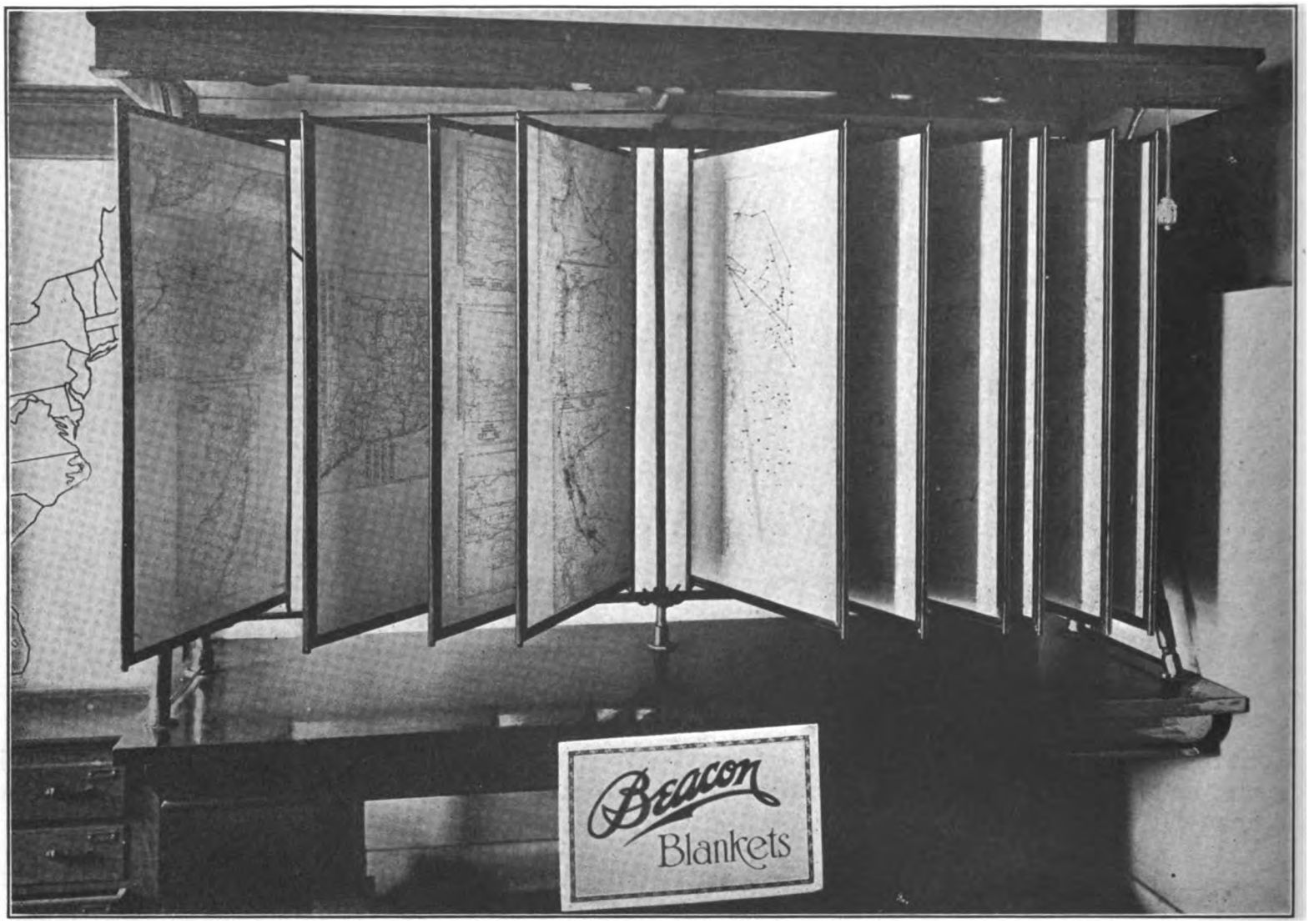
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YOU TOO MUST BE THOROUGH IN YOUR SALES METHODS

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Some Things This Outfit Can Do For You

1. Show routes to take to cover gaps in sales effort.
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Send me, without obligation, details of EDEXCO Swinging Leaf Fixture Map Equipment. I am especially interested in (check if you desire)

☐ Fixtures ☐ Map Mount ☐ Map Pins

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I also inclose ONE DOLLAR for Trial Assortment of Map Pins and Small Cork (EDEXCO) Mounted U. S. Map.

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A Map System is not just a Map System—It must be Dependable and Durable.

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In EDEXCO Pins the color is fused in the glass. It cannot fade and will not chip off. We have the largest assortment of shapes, sizes and colors available anywhere.

SERVICE—We intend to sell you only the outfit best for your purpose. You will find us glad to work carefully with you to attain that end.

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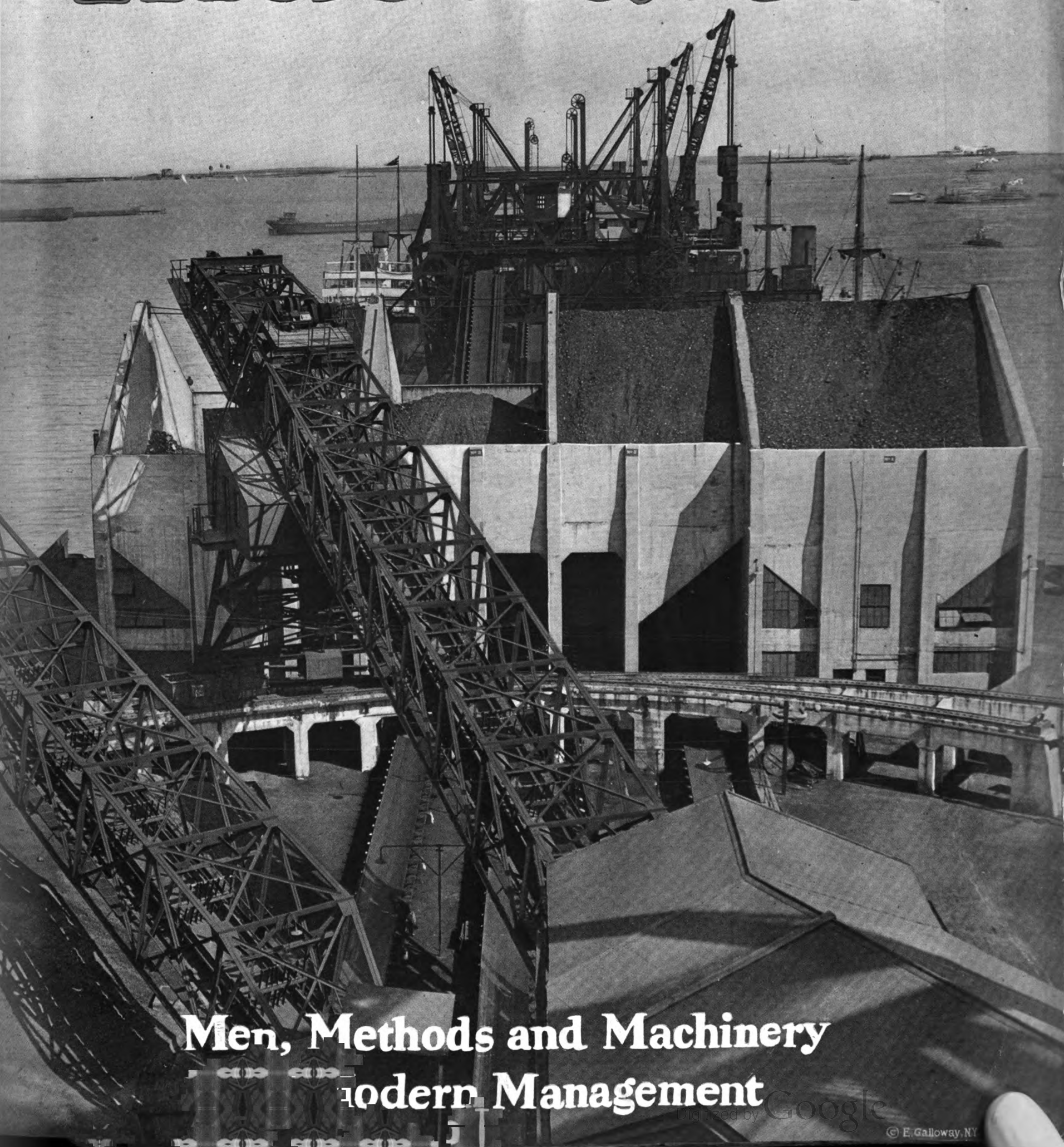
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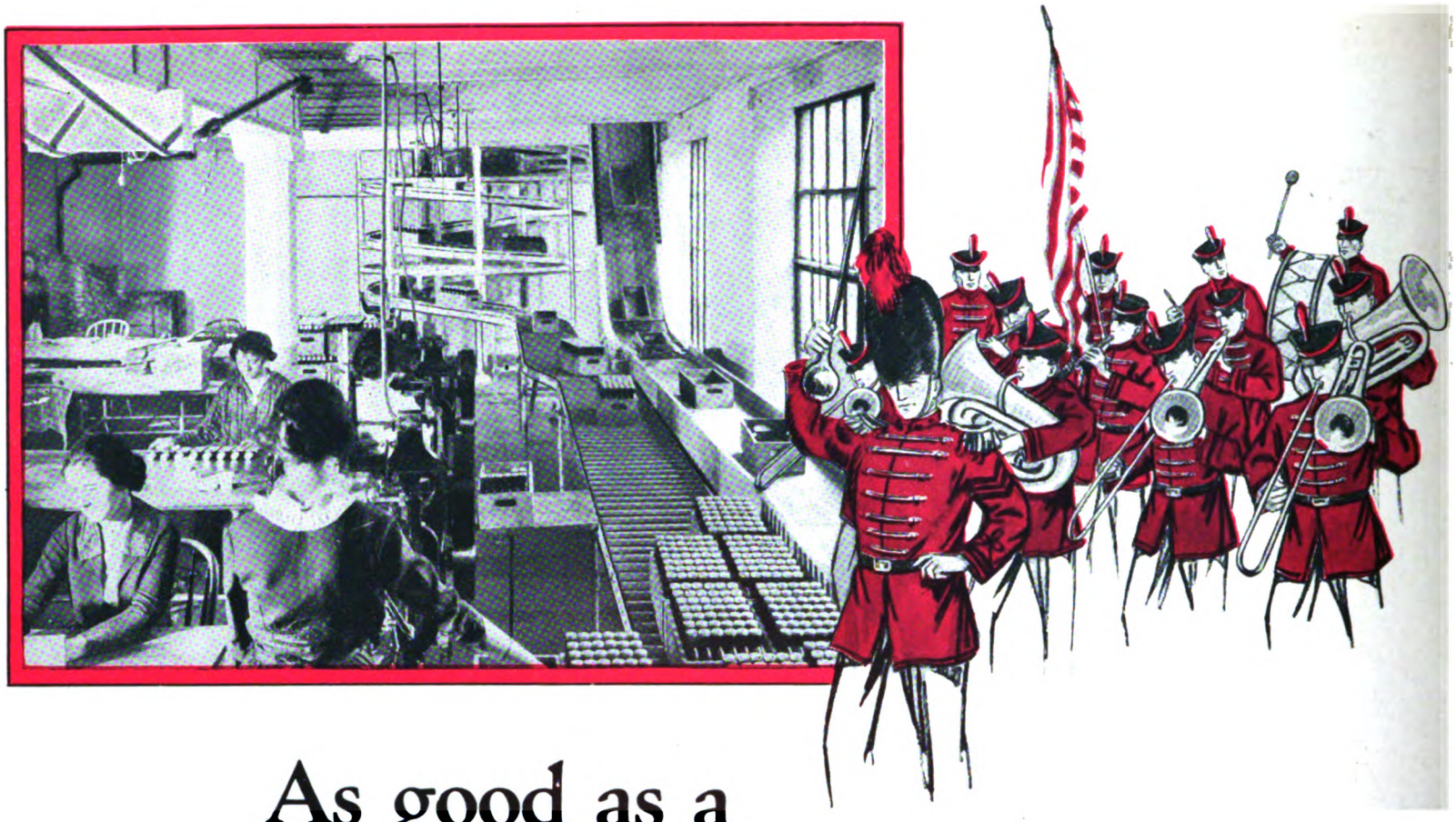
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Conveyors will bring this same rhythm to your plant. The workmen on your various machines become "tuned up" to a certain production rate set by the conveyors. You will find the output will greatly exceed the result from haphazard working. For the workers will unconsciously work at a more rapid rate and with less fatigue.

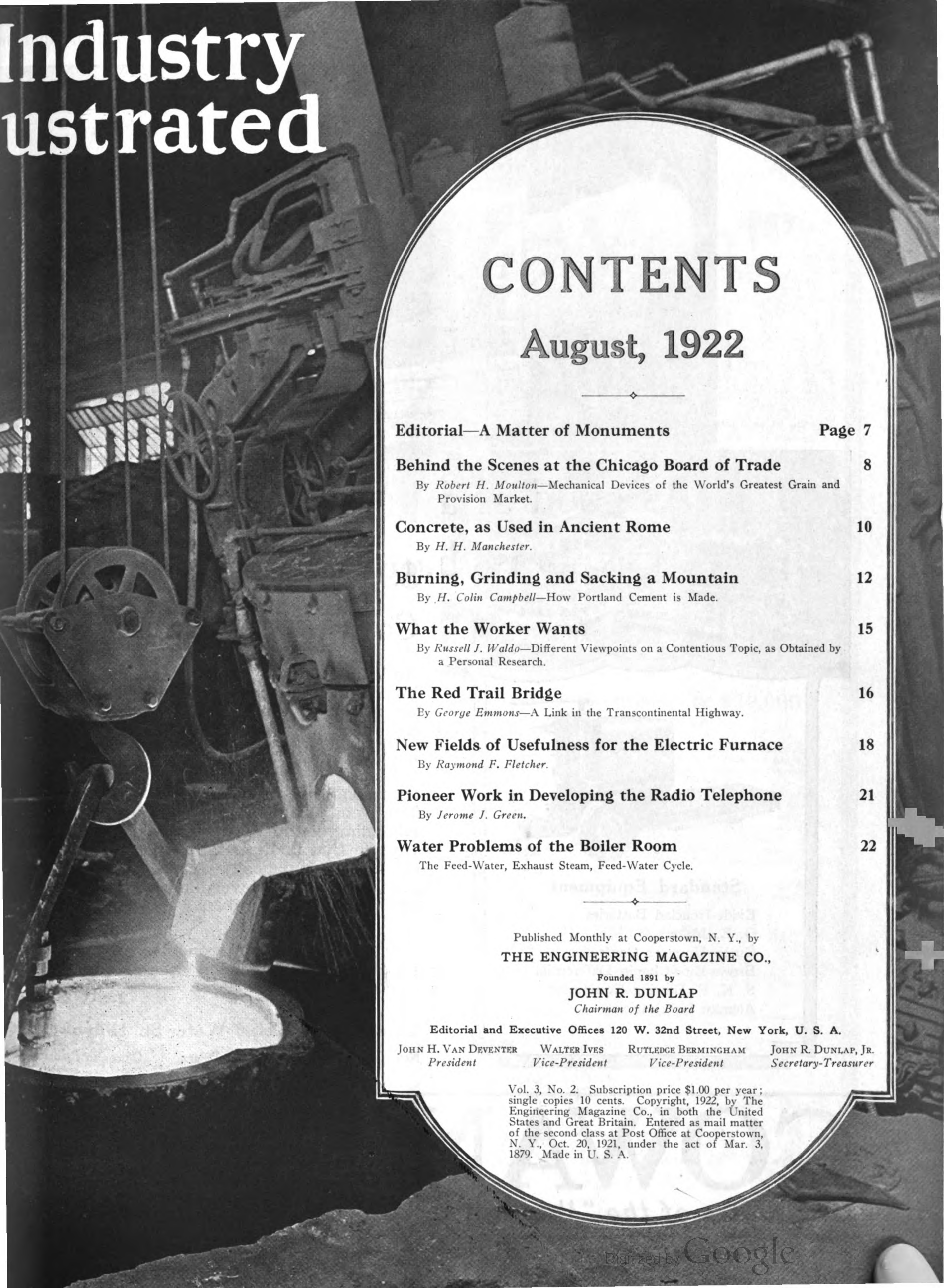
With conveyors, materials no longer stack up between machines, but go from process to process in an orderly way. This is the very life of efficient production, and only by mechanical conveying systems can this result be obtained.

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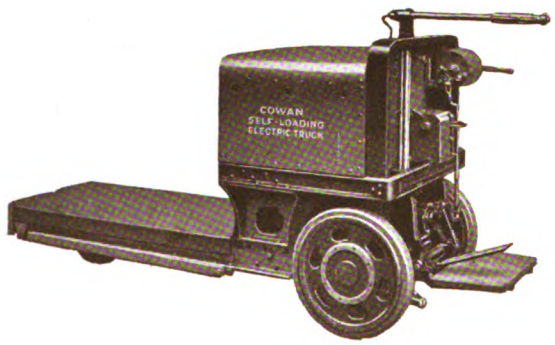
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And this is the saving in wages alone, in the Geo. W. Prentiss & Company plant at Holyoke, Mass., where one Cowan Electric Lift Truck replaces eight men.

In this plant manual methods of moving loads of rod and wire through progressive manufacturing operations have been replaced by the Cowan Lift Truck and skid method—practically eliminating all rehandling with its great waste in time and labor. Here, a Cowan Electric Lift Truck, operated by one man automatically picks up, conveys, and deposits skidded loads weighing hundreds of pounds; and, as well, hauls trailers.

A Cowan representative will gladly talk to you about effecting similar economies in your plant. Or we shall be pleased to send you a copy of Bulletin No. 5.

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New York Office: Grand Central Palace Offices in Principal Cities

COWAN INDUSTRIAL TRUCKS-TRACTORS

Originators *of the* "through ticket" *system for* moving loads

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"I took this chance and Won!"

"Jim, old man, how did you ever put it over?" It was after business hours, and Perkins---who asked the question---had stepped into the office of the newly appointed General Manager for a talk.

Perkins was sore. Until recently, both Edmonds and he had been Department Managers for the J. J. Black Manufacturing Company. But something had happened during the week just past to change all this. The former General Manager unexpectedly resigned. The Board of Directors met to appoint a successor. Edmonds got the job.

Perkins was stunned. Not because he had expected to get the position himself, but because he didn't see why Edmonds had landed it. He was frankly curious.

"Jim, old man, how did you ever put it over?"

Getting Out of a Rut

And then Edmonds told him. "Perkins, you and I were both doing the same kind of work. We knew our respective departments pretty thoroughly, but right there our knowledge stopped. We were strictly "one department men," and as such, our value to the Company was limited.

"We both worked pretty hard but we didn't seem to get ahead. We seemed to have found our level —it was just high enough to keep us from becoming discontented.

"But one year ago I woke up. An advertisement did the trick. It was a Home Study Course Advertisement—but not the usual kind. This advertisement offered me a Course of Study in Industrial Engineering and Factory Management. As a Factory trained man it appealed to me at once as an intensely practical course. It told me in plain fashion what I wanted to know.

A New Kind of Training

"I saw a chance to train myself, during my spare time, in the fundamentals of big business—a chance to study the basic principles which govern factory organization and administration, the selection and layout of buildings and equipment, the planning and routing of work, wage systems and bonus plans, cost accounting, the generation and use of power, the valuation of property, statistical control and all other factors which are conducive to maximum production at minimum expense.

"I acted then and there. I took this chance and won."

Thousands of factory trained men, among whom are presidents, general managers, superintendents, industrial engineers, foremen, cost clerks, accountants, storekeepers, inspectors and plain, every day workers at the bench have seized the same opportunity which came to Edmonds, and have been helped to bigger jobs and better salaries by enrolling in the "Factory Management Course and Service" offered by the Industrial Extension Institute.

An Organized Course of Study

This remarkable course is the only one of its kind in the world. It is a practical, non-technical course for the practical factory man. It is based on the University plan of organized study, consisting of lectures, talks, reading assignments, text books, problems and model solutions to these problems. The Consulting service, which is part of the Course, is intended to help you meet and solve the questions which arise in your daily business.

No University has been able to present a Course like this one. It would be impossible to hire as teachers the sixty prominent industrial specialists who have personally cooperated to produce the Factory Management Course and Service. The combined experience of men like Gantt, Towne, Babson, Ficker, Steinmetz, Franklin, Going etc., each a recognized expert in his own particular field—has been systematically arranged and presented in plain, understandable language so that you can profit by it.

You will understand what men at the top think about the "Factory Management Course and Service" when we tell you that 35 per cent of the last 1000 men to enroll were managing executives. This does not include any man below the position of superintendent.

Wanted—The $20,000 Man

The demand for men trained in industrial management is far greater than the supply. Big business is literally begging for the man who can hold down a $20,000 job.

Show your will power! Make up your mind to get out of the rut of routine and begin *now* to prepare yourself for a bigger, broader job.

The man who studies this course conscientiously will quickly qualify for greater responsibilities, and, what is much more important, he will find his qualifications recognized and the responsibilities thrust upon him.

You have read this advertisement. Now take the chance it offers you. Tear off the coupon below and send for:

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The rotor, the only moving part, is cast in one piece, the blades being rigidly reinforced by shrouds. The rotor is mounted on a short, stiff shaft supported at each end by the highest grade annular ball bearings mounted outside of the casing.

As the peripheral clearance is large, there is no possibility of the ends of the rotor blades coming in contact with the casing.

The original high efficiency is maintained indefinitely in continuous service.

The air is thoroughly washed during compression and contains no oil.

Hytor compressors occupy very much less floor space and are much lighter in weight than reciprocating compressors. They run without vibration.

The cost of installation is greatly reduced as no expensive foundations are necessary.

No expert attendance is required as there are no adjustments to make. The cost of upkeep is negligible.

Hytor compressors are quiet in operation.

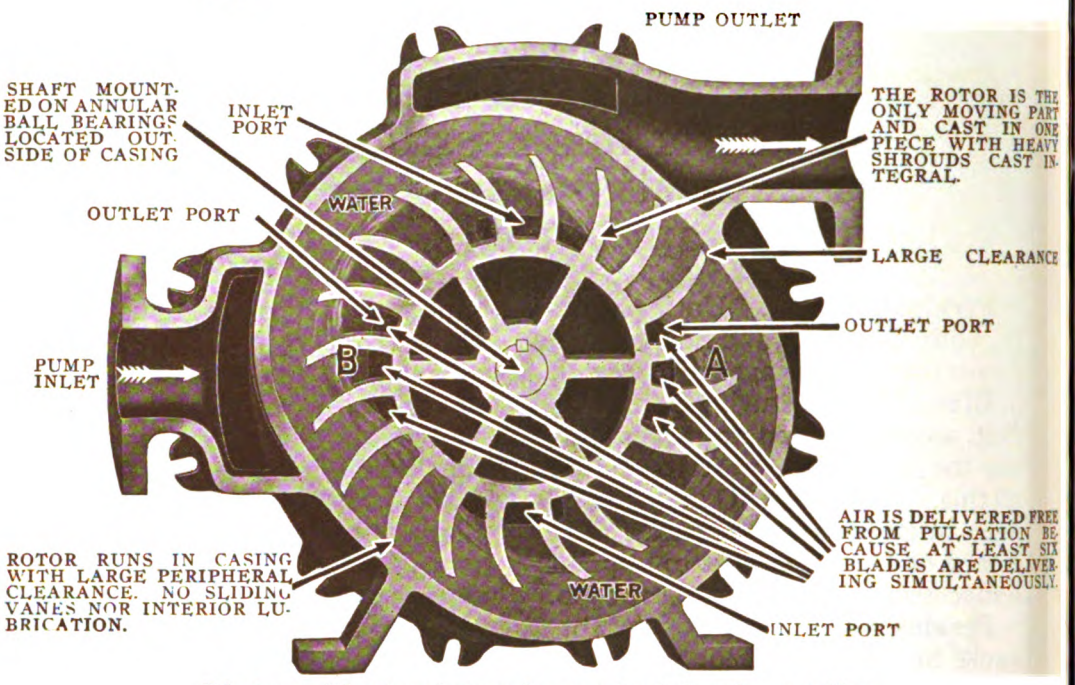
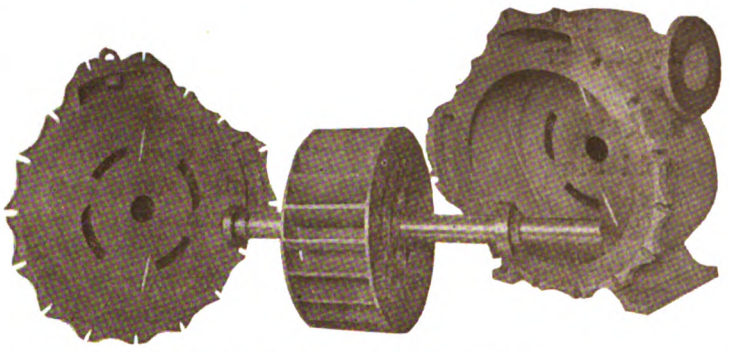


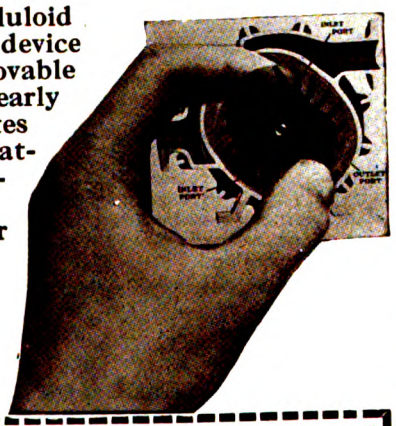
Diagram illustrating unique principle of operation



A ROTOR in hydraulic balance revolves freely in an elliptical casing filled with water. The water, turning, with the rotor, and constrained to follow the casing by centrifugal force, alternately recedes from and is forced back into the rotor, twice in a revolution. As the water recedes from the rotor it draws in air through the inlet ports. When the water is forced back into the rotor by the converging casing, the air is first compressed and then discharged through the outlet ports.

All the parts of the Hytor

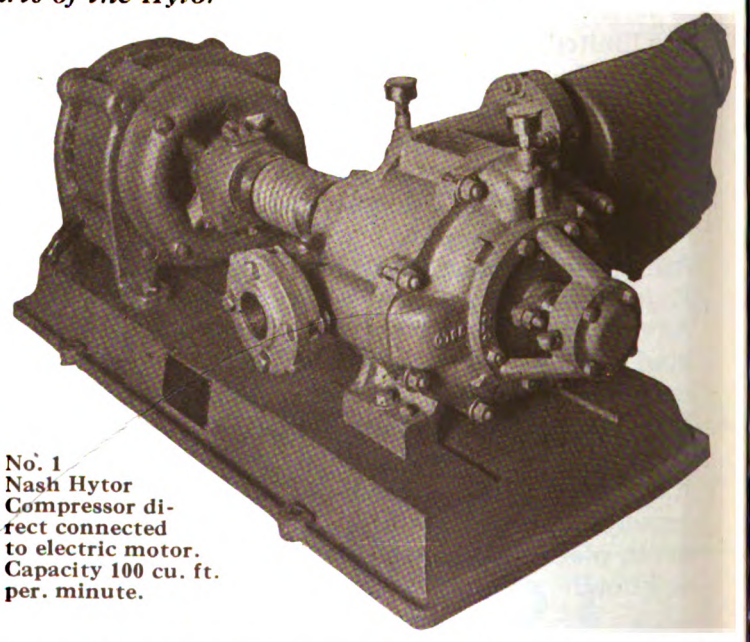
This celluloid graphic device with movable rotor clearly illustrates the operating principle. Send for your copy.



At pressures up to and including 15 lbs. per square inch, and vacuums up to 20 inches of mercury, the Nash Hytor affords the simplest and most economical means for handling air or gas, for all of the usual purposes where air under pressure is required, and they can be used on many special services for which the ordinary compressor is not adopted.

It is common practice in handling mildly acid vapors to re-circulate thru the pump an alkaline solution for the protection of the cast iron structure of the pump. In handling chlorine gas, concentrated sulphuric acid is re-circulated.

Air handled by the Hytor is delivered absolutely clean and free from dust or oil; a great advantage in the agitation of good products or in absorption processes where diffusion of air is accomplished by blowing thru filters, porous blankets or small orifices.



No. 1 Nash Hytor Compressor direct connected to electric motor. Capacity 100 cu. ft. per. minute.

5

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Industry Illustrated

John H. Van Deventer, Editor

W. Thomson Lees, Associate Adolf Schildkraut, Art Director Reginald Gordon, Associate

EDITORIAL

A Matter of Monuments

OF the ancient Seven Wonders of the World, only one remains—and that the oldest of them all, the Great Pyramid of Cheops. Built of huge blocks of stone, this monument stands some four hundred and eighty-one feet high and seven hundred and fifty-five feet broad at the base—a structure built solely by man-power.

According to earliest recorded history, when Cheops became king of Egypt some 6,000 years ago, he closed all the temples, abolished religious sacrifice, and made all the Egyptians labor on his monument—working in relays of 100,000 men every three months. And, says Herodotus, the ancient historian, in order to obtain the money necessary to complete this pyramid Cheops sacrificed the honor of his daughter, who built herself a smaller pyramid of the stones given her by her lovers.

We know that the stones were sawed by means of jewelled bronze saws set with corundum or diamonds. How they were transported after being sawed, and how the stones were set in place, remains an unsolved riddle. Nor do we know exactly how long it took to complete the work—though it is known that Cheops reigned for about twenty-six years, and this pyramid was his life-work.

The enforced labor of one hundred thousand men employed for probably a quarter of a century—enforced labor which interfered with the people's accustomed pursuits and took no care for their wishes or happiness—and all for the glorification of one man!

Contrast this with the most modern of industrial Wonders of the World—the Ford Motor Company. Founded on the vision of one man for supplying a commodity of universal use, quicker and cheaper transportation, this undertaking has grown into a stupendous project whose development has not yet even begun to reach its full scope.

Started only twenty years ago, dependent not upon the power of a king to draft labor, but upon the ability of a man to attract labor; employing this labor not for self-aggrandizement, but for the realization of a universally beneficial idea; handling this labor not to interfere with the worker's happiness, but instead increasing both his happiness and his self-respect through common sense methods—and thereby, in a period of strikes and general unrest establishing the enviable record of never having had any labor troubles—these things, and others too numerous to mention, make this a monument beside which the Great Pyramid of Cheops sinks to insignificance.

It is not birth, but brain-power, that makes a man powerful today and enables him to make a lasting impression on his times. It is not the size of his creation, but the measure of its benefit to others, that determines the greatness of the monument by which his memory shall be preserved to future ages.

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Behind the Scenes at the Chicago Board of Trade

Mechanical Devices of the World's Greatest Grain and Provision Market

By Robert H. Moulton



Telephone operators signaling orders to brokers in pits.



Man at right writes prices on slips of paper and passes them to man at left who stamps them with chronograph (shown under his right hand) and hands them to telegrapher above.



Man in center stamps slips of papers on which prices are written with a second chronograph and hands them to telegrapher (seated) who transmits the information by Morse code to office of the ticker company.



At the right—Telegraph department of the Board of Trade.

CHICAGO is the greatest grain and provision market in the world. Here four hundred million bushels of grain are received annually, and six hundred million pounds of pork. And the Chicago Board of Trade, on whose floors trading in wheat, corn, oats, rye, barley, and pork products takes place, is an integral part of the distributive center by which this great food stream is regulated; the Board may, in fact, be called the very nerve-center of the grain trade of the world, since here are reflected world-wide conditions as regards growing crops, and the movement and consumption of crops.

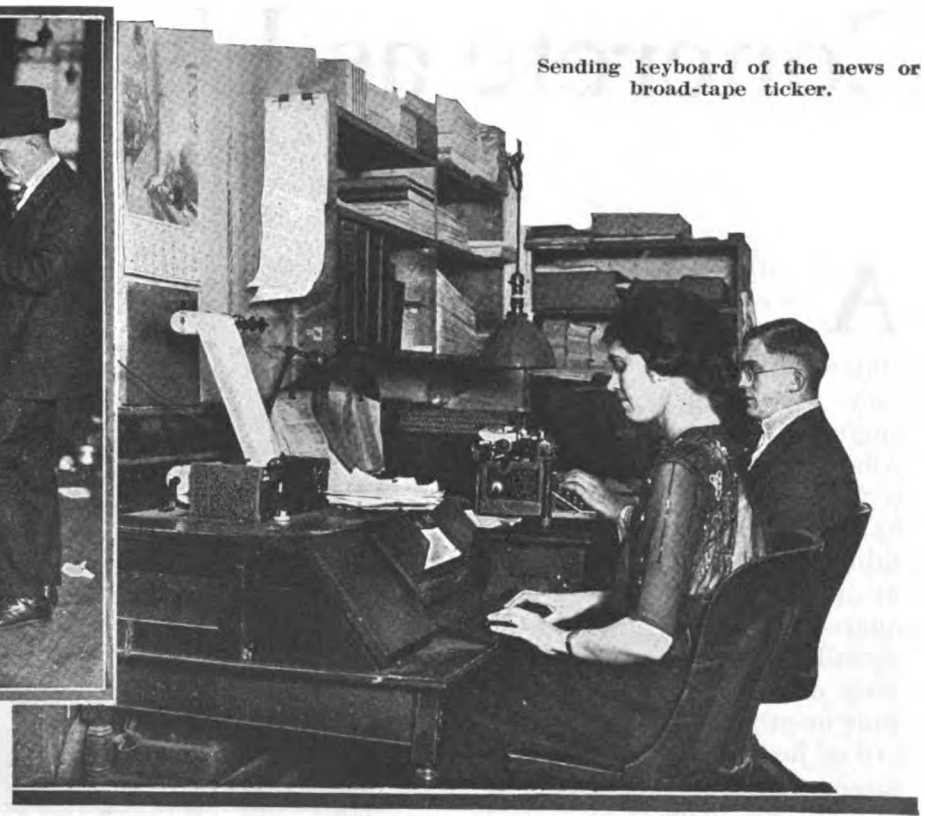
There are few outside of the grain and provision business, however, who know that the Chicago Board of Trade itself does no business, but merely provides a place where buyers and sellers the world over, through their representatives, meet and trade in these commodities.

In order that buyers and sellers may have all information possible to guide them in reaching their opinions as to values, the exchange acts as a clearing house of data upon

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Quotation tickers at left; news or broad-tape tickers at right.



Sending keyboard of the news or broad-tape ticker.

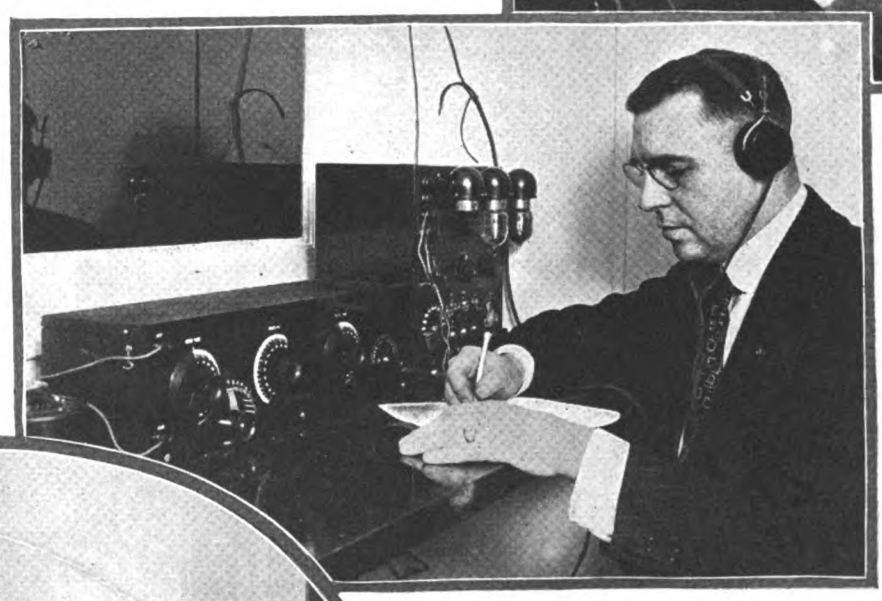
crop conditions, shipments, visible supply, and so forth. Through a wonderful system of news service, necessitating the cooperation of thousands of correspondents and agents, there is collected here all information which is likely to have any effect upon the trade, including prices of the different commodities in every considerable market throughout the world, and this information, with absolutely no restrictions, is sent broadcast for the benefit of producer and consumer alike, without prejudice and without partiality.

There are two classes of transactions on the Chicago Board of Trade. The first is what is known as the "spot" or cash transaction and takes place in much the same manner that sales of other commodi-

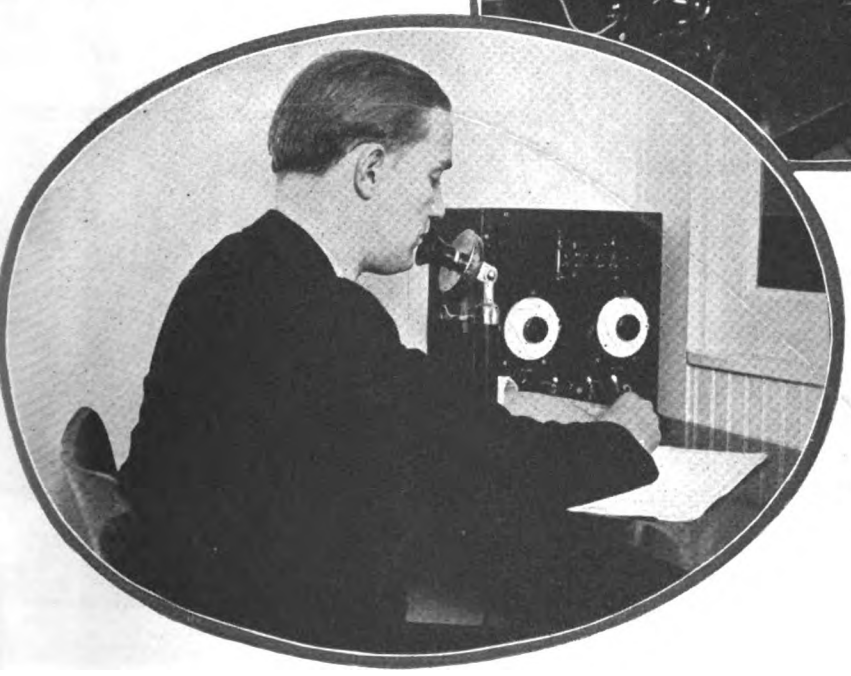
(*Continued on Page 26*)



Ticker keyboard operator receives prices by Morse code (through medium of telegraph sounder) from telegrapher near the pit and retransmits it over the line to the tickers.



At the left—Radio department of the Board of Trade, showing receiving apparatus, used in verifying information sent out by the Board of Trade and in receiving information from other stations.



Showing how the news or broad-tape ticker prints items.



Left—Radio department of the Board of Trade, showing sending apparatus.

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Concrete as Used in Ancient Rome

By H. H. Manchester

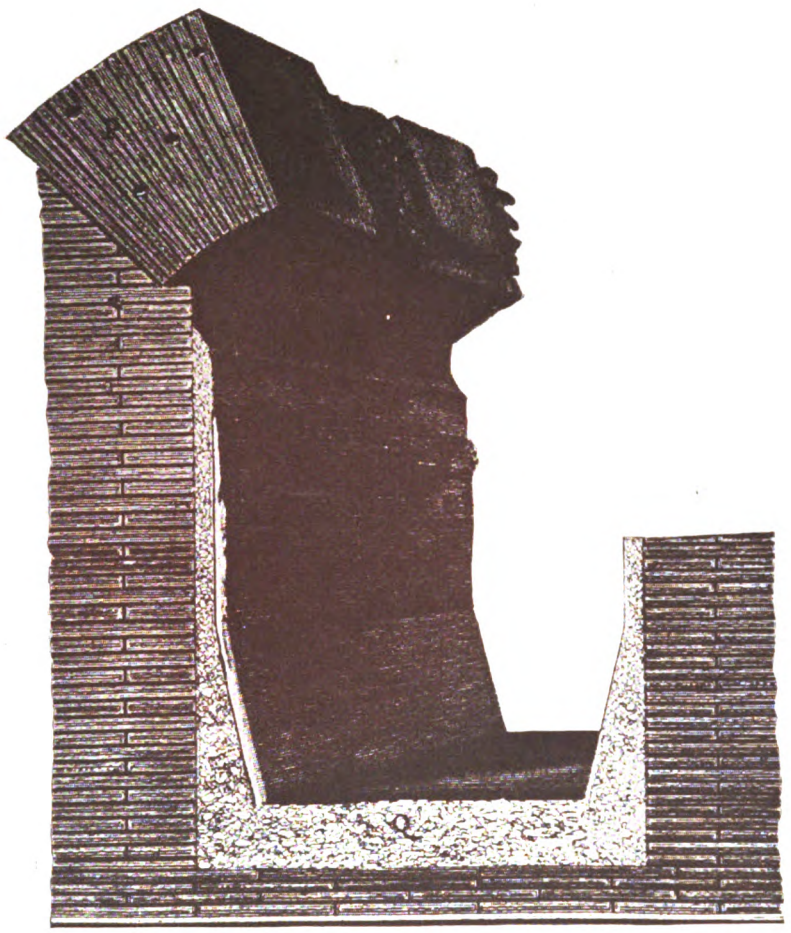
ALTHOUGH the Romans were very far from having the artistic architectural sense of the Greeks, they were immensely greater engineers, and as practical as Americans have been charged with being. They made a habit of looking over everything they found around them or in the countries they conquered, and applying it to the upbuilding of Rome and other uses of their own. At some time or other,—there is no record of just when,—the Romans discovered that the lava or rocks of the district which had been covered by volcanic eruptions, made a cement which was unaffected by water and would even harden under water. They of course knew nothing of the chemical reasons for this phenomenon, although at the period there was considerable discussion about this pozzolana, or burnt earth, which constituted the cement.

Vitruvius, the Roman architect who lived about the beginning of the Christian Era, gives his version of the nature of pozzolana in a passage which runs in part as follows:

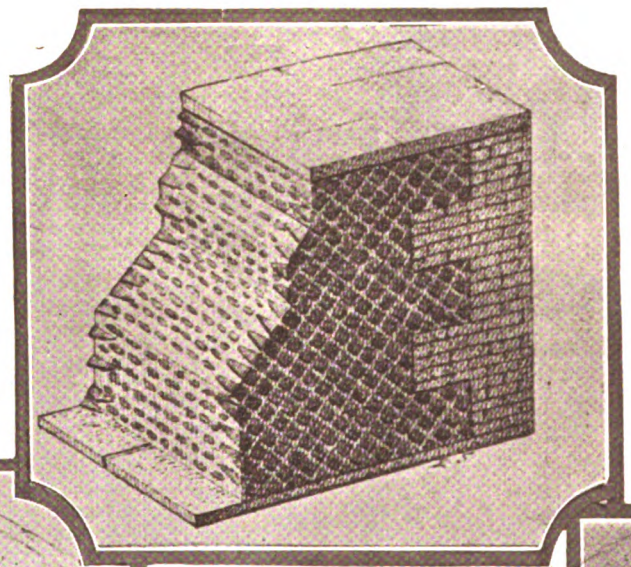
"There is also a sort of powder which by nature itself causes remarkable results. It is found in the district about Baiae and in the neighborhood of the towns round about Mt. Vesuvius. This substance when mixed with lime and rubble, not only produces strong buildings of other kinds, but even when piers of it are built in the sea, they set hard under water. The reason for this seems to be that the earth on the slopes of the mountains in these districts is hot and full of hot springs. This would not be true unless the mountains had under them great fires of sulphur or alum or asphalt. So the fire and the heat, coming up hot from far within through the fissures, make the soil there light, and the tufa found there is spongy and free from moisture. Hence when the three substances, all formed on a like principle by the force of fire, are mixed together, the water suddenly taken in makes them cohere and the mixture quickly hardens so that it sets into a mass which neither the waves nor the force of the water can disintegrate.

"The sort of spongy-stone found in this region is not produced everywhere, but only about Aetna and among the hills of Mysia, which the Greeks call the "Burnt District," and in other places of the same singular character. Since in such places there are found hot springs and warm vapor in excavations on the mountains, and the ancients tell us that there were once fires over the fields in those very regions, it seems certain that moisture has been driven from the tufa and earth by the force of fire, just as it is from limestone in kilns."

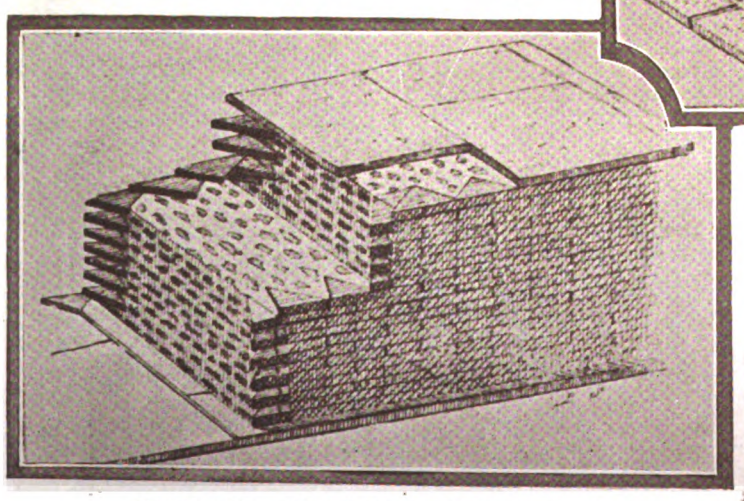
It is a sad commentary on Vitruvius' remarks, that the



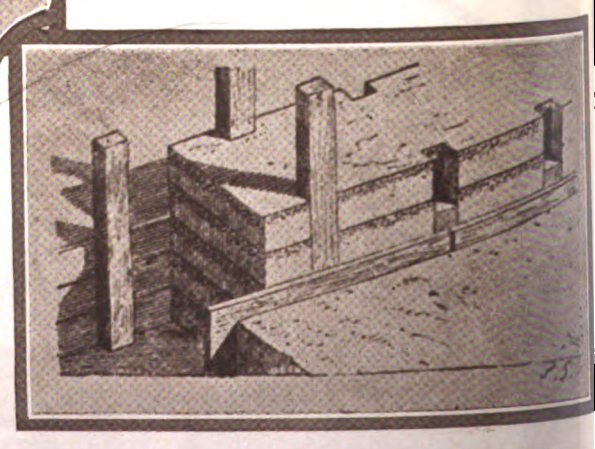
An ancient Roman aqueduct, lined with concrete and finished off with cement.



Reticulated facing on concrete, as used in an ancient Roman wall.



Cross-section, showing one of the methods used by the Romans in facing off concrete work; triangular stones or bricks embedded in the mixture.



The Roman use of molds in their concrete construction. Only very recently have we made any radical improvements in the forms or molds over those used two thousand years ago.

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A bas-relief on Trajan's column shows the manufacture and use of concrete slabs by soldiers for constructing breastworks.

volcanic eruptions which he placed in the almost forgotten past, were so soon renewed and swept over Herculaneum and Pompeii.

At first the Romans in their concrete regularly made use of lumps of tufa, but later they employed lava travertine, broken bricks, and all the chips from the stone mason's yard.

Employing this concrete, they developed a new style of architecture in which great spaces were covered with vaults and domes cast in semi-fluid concrete. This gave the form of the arch without the heavy thrust which would have resulted from true arches.

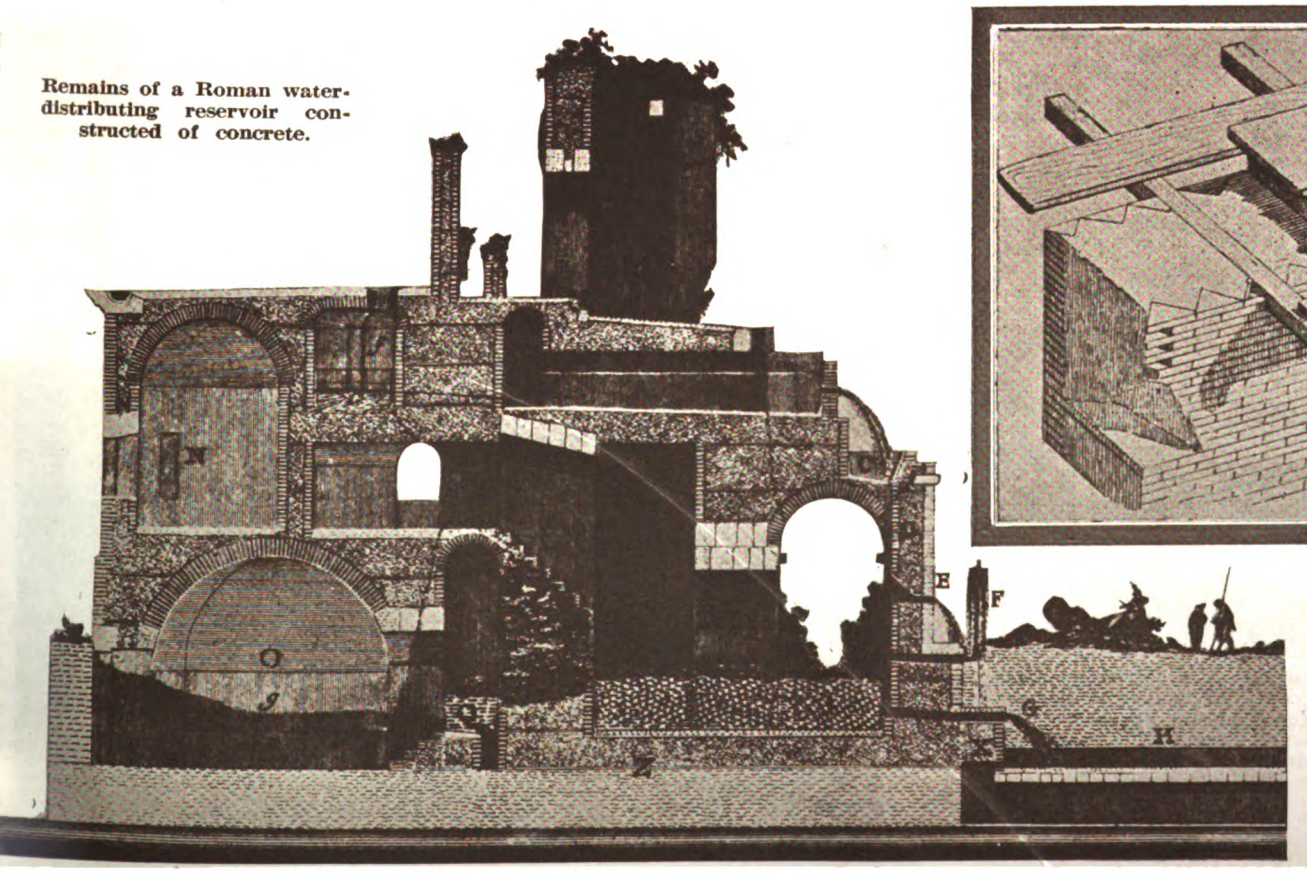
Massive walls were constructed with the use of molds. Upright timbers from 10 to 15 feet long were fixed in rows on each side of the wall to be made. Then planks about ten inches wide were nailed to them so as to form a mold into which the half-fluid mixture of pozzolana, lime, and stones was poured. From the remains it may be seen that a tier of concrete about three feet high was made at a time, in order to allow for proper drawing and setting. When this was hard, another tier was cast on top of it, and when necessary the mold was removed and placed on top of the latest tier.

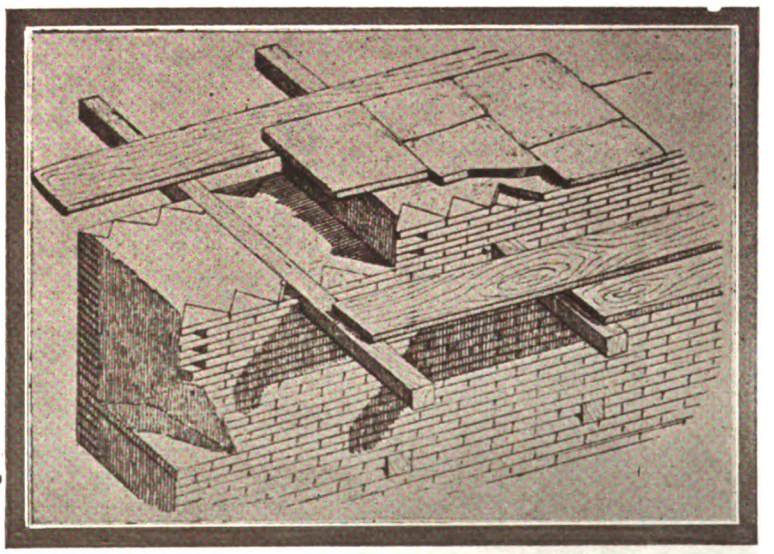
The foundation was left of uncovered concrete, but the upper walls, for the sake of appearance were usually faced with brick or stone. The walls of the pantheon for example, were of concrete about twenty feet thick; while the facing of brick was only about half a foot in thickness. There were various geometric methods of arranging the brick, the most popular of which seems to have been the opus reticulum or net-work pattern.

Just why the Romans

(Continued on Page 42)

Remains of a Roman water-distributing reservoir constructed of concrete.





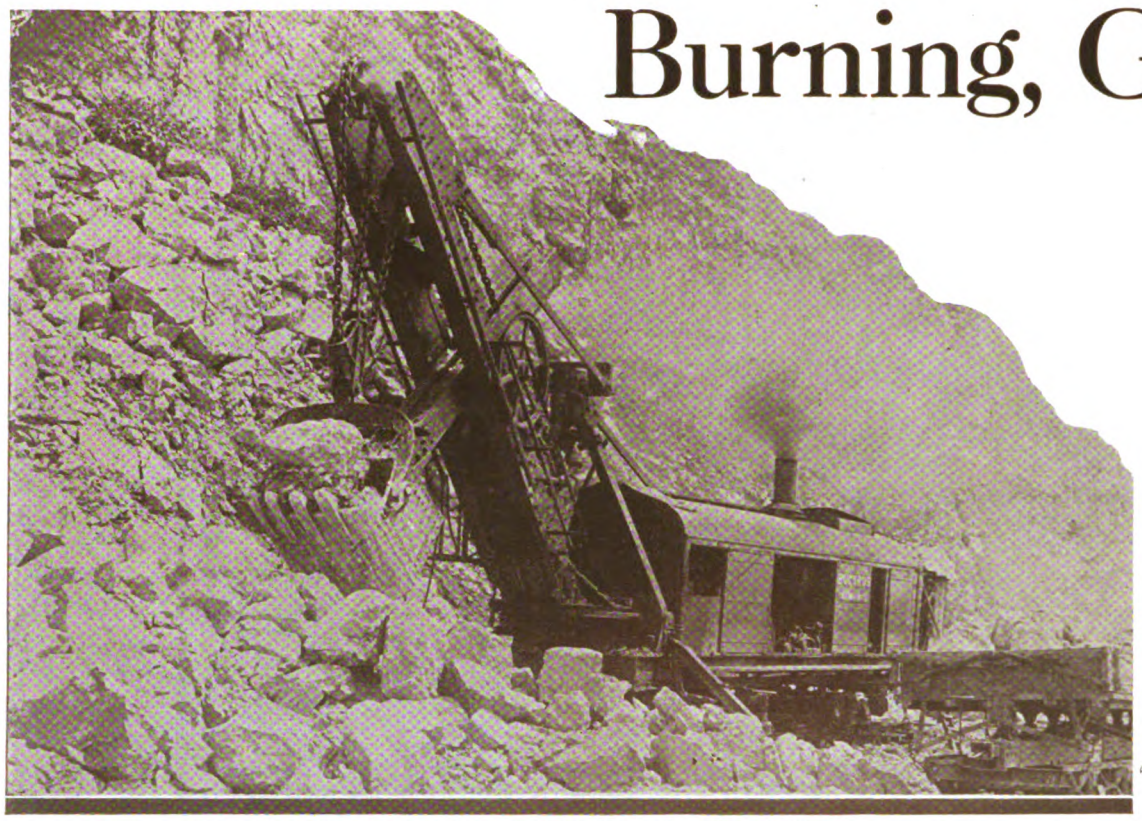
Layers of concrete interspersed with brick slabs and faced with brick. A common method of wall construction at the dawn of the Christian Era.

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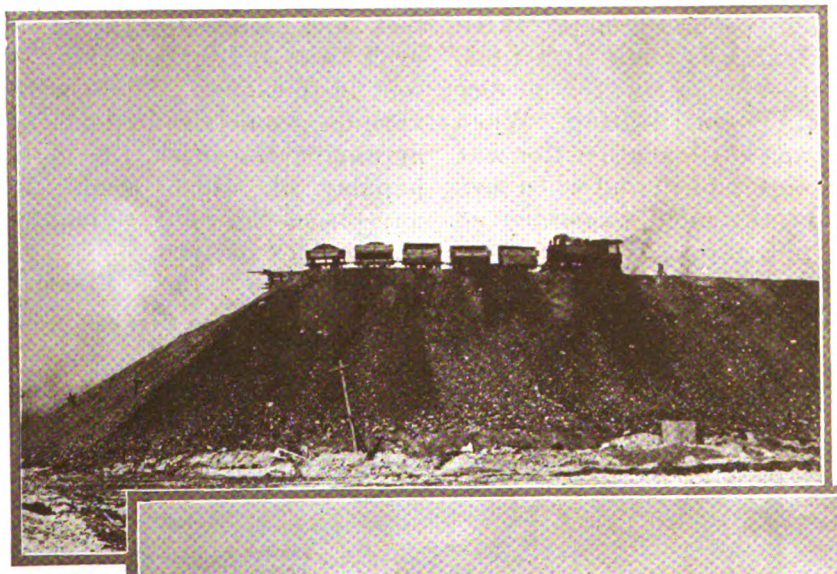
Burning, Grinding and

How Portland

BY H. COLIN



The materials from which cement is made are widely distributed in practically inexhaustible supply. But it is a long stretch from rock in the quarry to the finished product known as portland cement. This picture shows the face of a cement rock quarry from which some of the raw material is obtained after blasting. In 1921, 14,000,000 pounds of explosives were used by cement manufacturers in loosening or breaking up rock so that it could be handled by the mill crushers. Incidentally, there were but seven fatalities recorded as the result of using this enormous quantity of explosives. This is probably explained by the ceaseless accident prevention campaigns carried on among workmen by the individual mills.



Not all is gold that glitters, as is evidenced by this photograph which shows a portion of the huge quantity of "wasted" material that must be stripped from the top of the cement rock deposit. This has to be moved a sufficient distance away from the seat of quarrying operations so as not to interfere with that work and involves railroad tracks, cars, and locomotives, and frequent relocating of such tracks as the pile of waste increases.



After having been loosened by explosives, cement rock is loaded into dump cars and hauled to the crusher house where it is reduced in size by putting through powerful gyratory or similar crushers. See photograph at the right.

THIS is a real mountain. From it there comes an average of 400,000,000 sacks of portland cement a year—100,000,000 barrels. A trip through a cement mill shows many sidelights. Nearly one hundred different processes must be brought to bear upon the rock blasted from the face of the quarry before the resultant dry-as-dust material can be given its commercial name.

Drilling in the limestone and shale quarries naturally precedes blasting. Then for the twelve-months' production you must shoot off 14,000,000 pounds of dynamite or other high explosives.

Not all that goes into a barrel of cement comes out. It takes one ton of rock to make three barrels of cement—a loss somewhere of 800 pounds of raw material. Pop-shooting follows blasting in order to break large rock into pieces that can be handled by the steam shovel for loading into the cars that haul the raw material to the crusher.

Power in enormous volume must be directed toward crushing this material, drying it, grinding it, handling and rehandling to and from storage, conveying to elevators, kilns, finishing mills, etc. An idea of the power required is learned from the fact that the electrical energy alone required to produce a barrel of cement would cost at household rates more than the average price of cement at the mill. This illus-



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Sacking a Mountain

Cement is Made

MPBELL

rates the economies which in-
dustrial management effects.

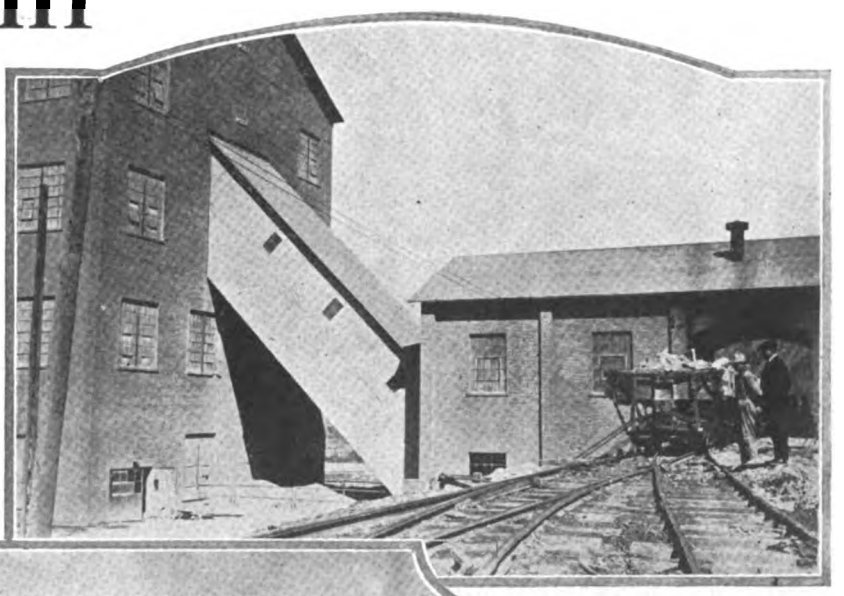
If you were a jobber in fuels
ou could well afford to spend
good sum of energy to get
n order from the cement in-
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arrels of fuel oil, and a good
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as. This makes anyone who
as to think about keeping his
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rices, feel glad that he isn't
unning a cement plant also.

The industry has to go out
n the market for other things
hat "go into" a barrel of ce-
ent. To keep machinery
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imes as rapidly as it does in
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are, nearly 3,500,000 pounds
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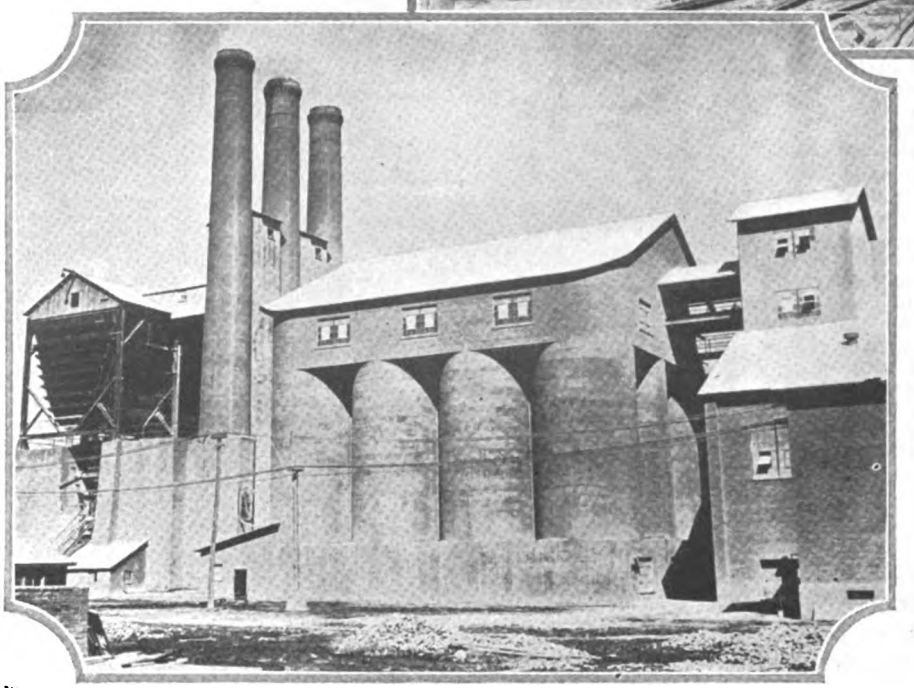
1,500,000 linear feet of belt-
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4,000,000 fire bricks to line
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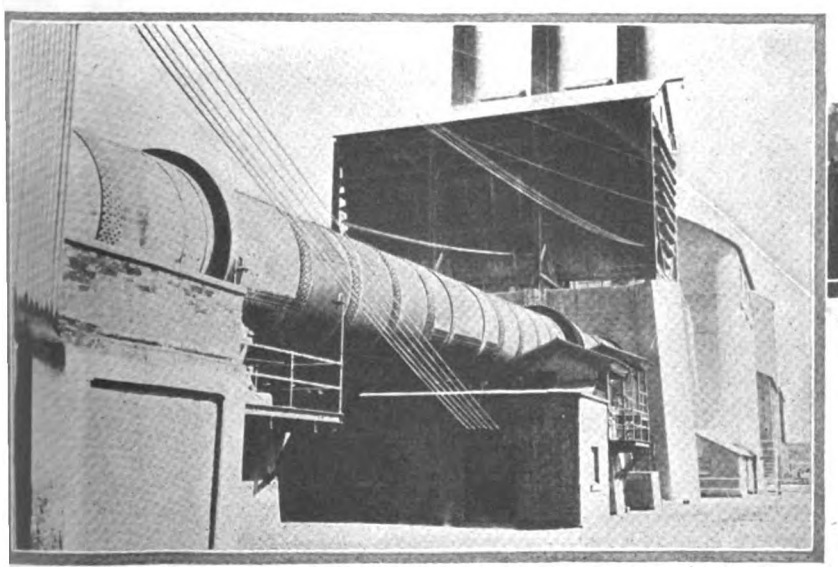
300,000,000 cotton sacks to
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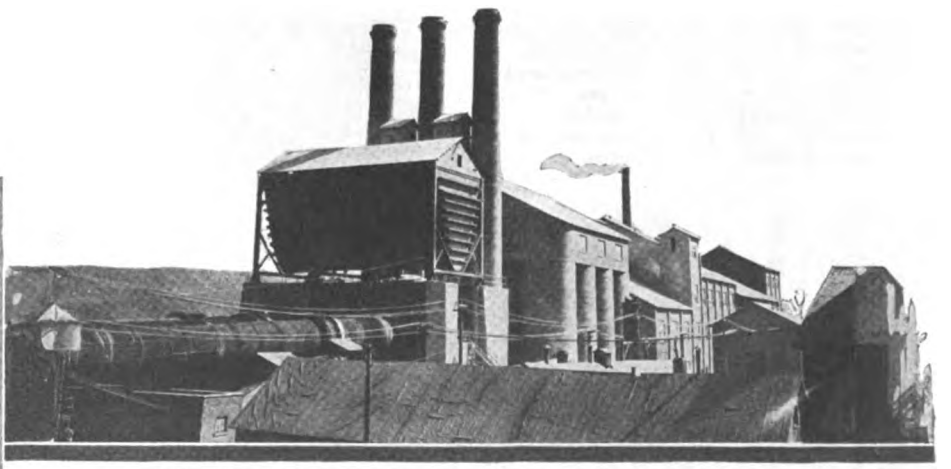


From the pit beneath the crusher, the reduced material is elevated in the inclined bridge shown in this picture to feed storage over secondary crushers. In these crushers the materials are still further reduced in size so that the particles after passing through dryers can be put through the first grinding preparatory to burning.



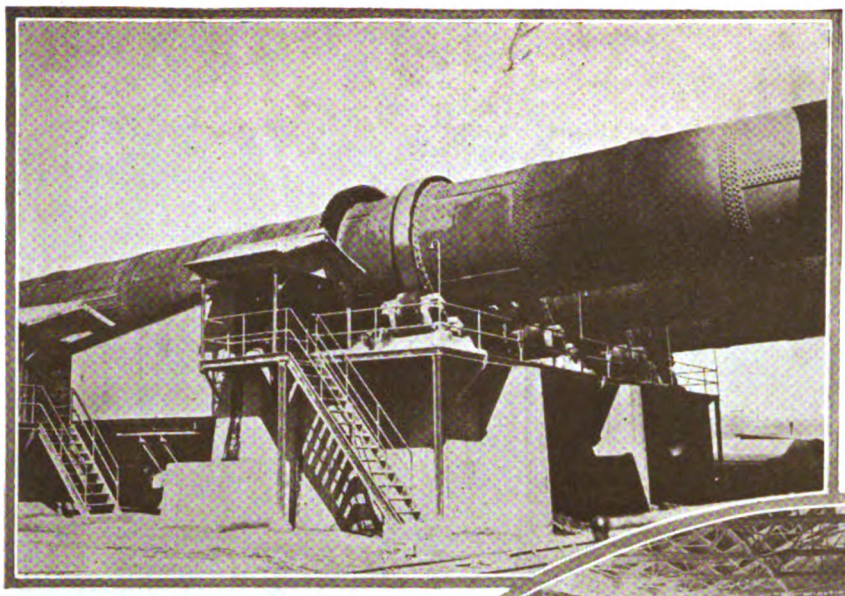
In order that the cement plant may not have to operate intermittently considerable storage space must be provided for raw materials. This battery of huge concrete tanks is for storing ground raw material. They must be water proof and capable of withstanding heavy internal pressure. They are therefore the subject of engineering design based on the requirements to be met.



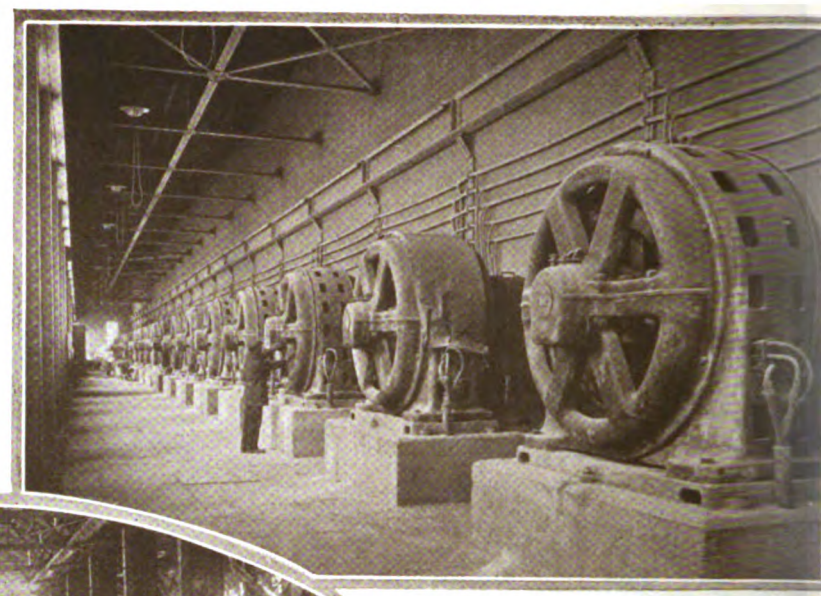


This view shows a part of the "straight-line" arrangement of the buildings in a modern cement plant in order to facilitate direct and uninterrupted progress of the handling of materials through various stages to finished portland cement. In the middle foreground are the kilns, next in line with the storage bins for raw materials referred to in the last photograph. The raw materials are fed into these kilns for burning and in their passage through the kilns encounter various degrees of heat until at the discharge end where fuel in the form of natural gas, oil, or pulverized coal is fed into the kiln, they are reduced to a glass-like, hard clinker. At the left is a close-up view of a kiln.

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The immense length and diameter of cement kilns and the fact that they are charged throughout this length with a heavy load of materials requires that they be supported at suitable intervals on trunnions resting on firm foundations. The driving mechanism is also located at this point since the kilns must be revolved at a determined speed in order to properly expose the contents to the heat necessary for burning the clinker. It might be interesting to here mention that the energy of the power and coal required to make a ton of cement would be sufficient to drive a five-passenger touring car 1,200 miles over the finest type of paved road. This would cost in gasoline alone more than two and one half times as much as the total cost of a ton of cement at the mill.



In some of the more modern cement plants electric power reigns supreme. This photograph shows the motor room in a large cement mill, each motor being connected to a large cylindrical machine in which the clinker is ground into finished cement. These machines are known as tube mills. This pulverizing is done in part by using in each one of these mills tons of the hardest kind of steel balls and tumbling the contents around until attrition has reduced the cement to such fineness that more than 78 per cent will pass through a sieve having 40,000 meshes per square inch.



These are the tube mills in which the clinker is ground. These are referred to on Photograph above.

and textile industries. Incidentally, replacements of sacks each year require a strip of cotton fabric 30 inches wide and 23,000 miles long—7,000 acres.

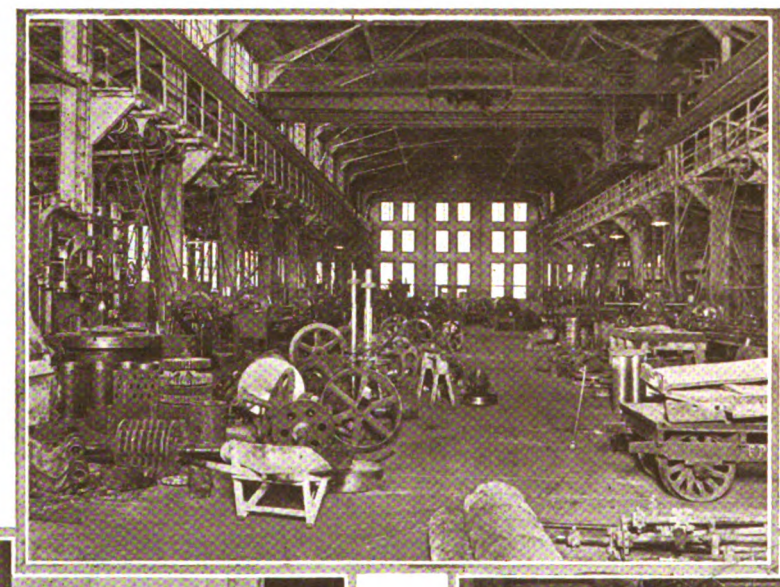
Multiplication helps to show the importance of some things. If a single sack-filling machine had to work at sacking one year's consumption of cement it would require 24-hour per day operation for 180 years to complete the job.

In cement manufacture coal is burned as a powder. It is a good deal like a blow-torch operation. 5,500 000 tons of the coal consumed by the industry was pulverized for use

(Continued on Page 38)

Portland cement is a product resulting from mechanico-chemical processes. So-called standard specifications which have been formulated for the purpose of establishing minimum requirements of quality are very exacting. An exact balance of the raw materials used must be maintained at all times and to check possible variations in chemical content and physical requirements continual testing of both raw materials and finished product is carried on. The chemical laboratory of a modern cement plant is therefore a very important detail in manufacture.

The larger mills maintain enormous machine shops in order that repairs may be quickly and effectively made.



The sacks are permanently tied at the top with wire ties and filled through a valve at the bottom. If all of the cement manufactured in one year was shipped at one time it would require 400,000,000 sacks at least to move it once and there would be no sacks left in the mill for future production. Consequently, there is an enormous amount of money tied up in sacks necessary to handle the output of the mills. It is estimated that 300,000,000 square yards of cotton-duck are required annually to maintain the stock of sacks necessary to keep the cement production of the mills moving. Because the sacks are valuable they are repaired as often as such repair will make them fit for further use.





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What the Worker Wants

Different Viewpoints on a Contentious Topic, as Obtained by a Personal Research

By Russell J. Waldo

AFTER hearing unreasonable assertions regarding what the working man really wanted and what the employer *believed* he wanted I set about to discover what the worker really wanted and to get the information direct from him. There was in my opinion only one best method to use. This was to lay out questions and allow the worker to answer them.

The questions asked in "The Employees Questionnaire" were put to a few over one thousand workers in Buffalo, Cleveland, Toledo, South Bend, and Indianapolis. As the findings were practically the same in every locality I shall not separate them as to locality. However, I shall give my figures for the various questions. In every case the worker was actually a worker in the production end of the game.

Question 1—*In choosing a place to work do you look for a place where they want you to advance and give you every chance or do you go where they simply want you to work?*—brought out some very interesting information. Eight hundred and three would work only where they would be given every opportunity to be promoted. One hundred and twenty-three stated that they didn't care as long as there was work. One said that he had never been given a fair opportunity to advance and would like to have one to see what they were like. The remainder said it was immaterial to them.

In question 2—*Do you object to the first training which is often given in vestibule schools on entrance?*—I found no objections although one fellow said that "if the employer was half as anxious about your work after you were in as the instructor in the school was it would be a pleasure to work in some places."

Question 3—*Would you work in a poorly ventilated factory?*—with the exception of twenty-six, answers were against the poorly ventilated factory. The twenty-three did not care as long as the firm paid enough money.

Six hundred in answer to question 4—*Would you rather eat a warm meal in a company restaurant served at cost or would you rather carry your lunch from home?*—would rather eat a warm meal. Two hundred and seventy-five would rather eat at a company restaurant if they could get what

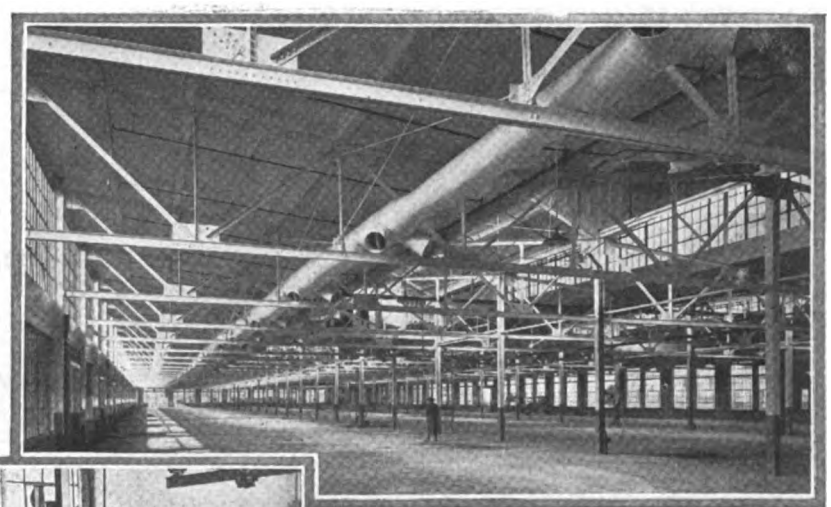
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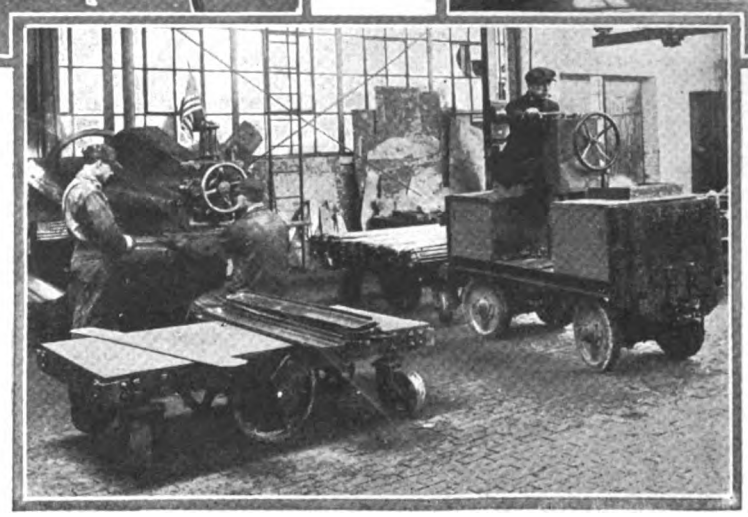
The average employer would be astonished to know how many men spend their rest periods in this pretty little nook on a factory property in New York State. Ask these men whether surroundings make a difference.



Below—A lunch-room which really fulfills its mission, both as a convenience and as an economy for the men.
(Photo Courtesy of Sani Products Co., North Chicago, Ill.)



Below—Light, air and ventilation were considered well worth attention in the planning of this building.
(Photo Courtesy of Ferguson Company, Cleveland, Ohio.)



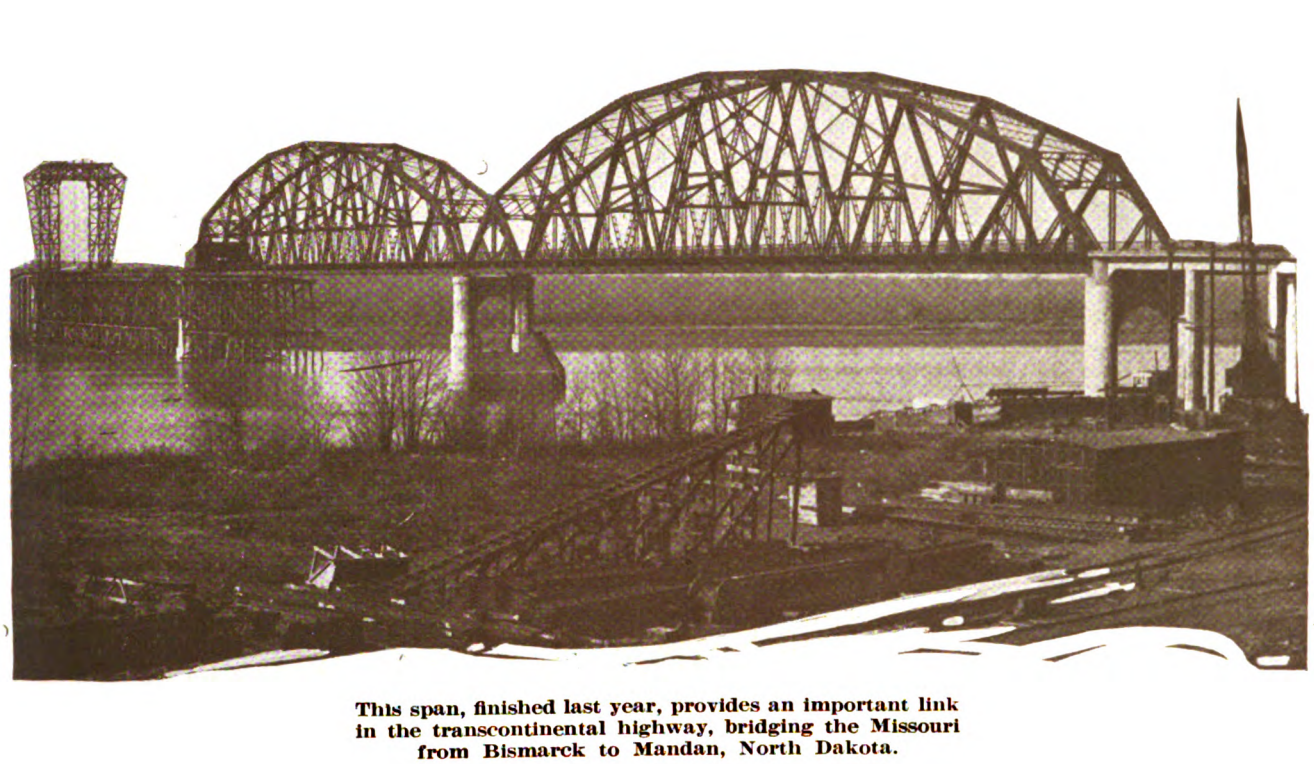
These men not only appreciate the use of modern transportation methods, but brag about their organization—taking pride in "our factory" and "our methods."

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The Red Trail Bridge

A Link in the Transcontinental Highway

BY GEORGE EMMONS

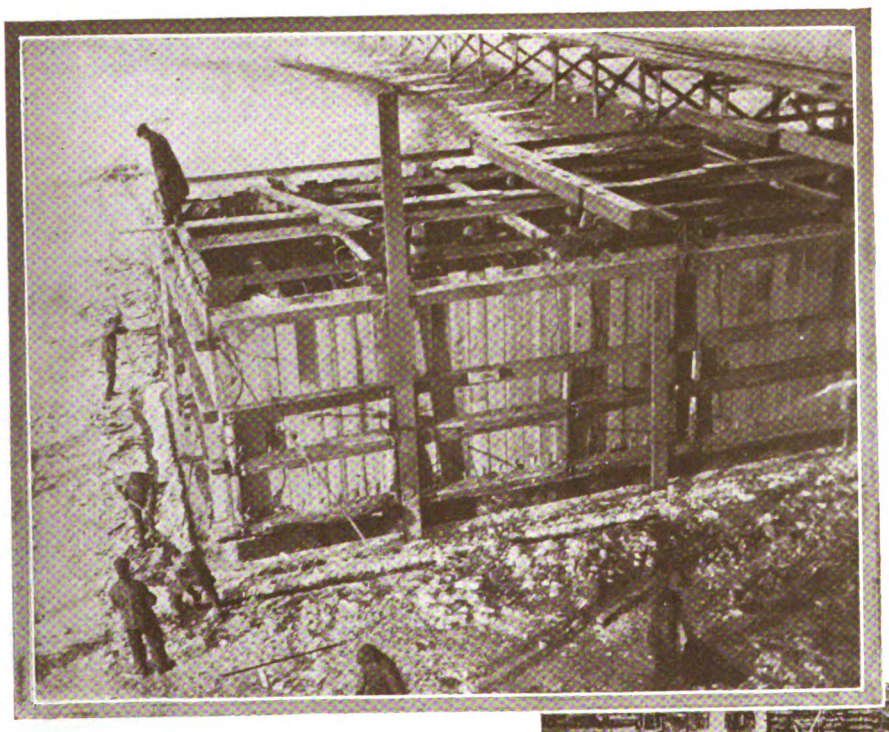


This span, finished last year, provides an important link in the transcontinental highway, bridging the Missouri from Bismarck to Mandan, North Dakota.

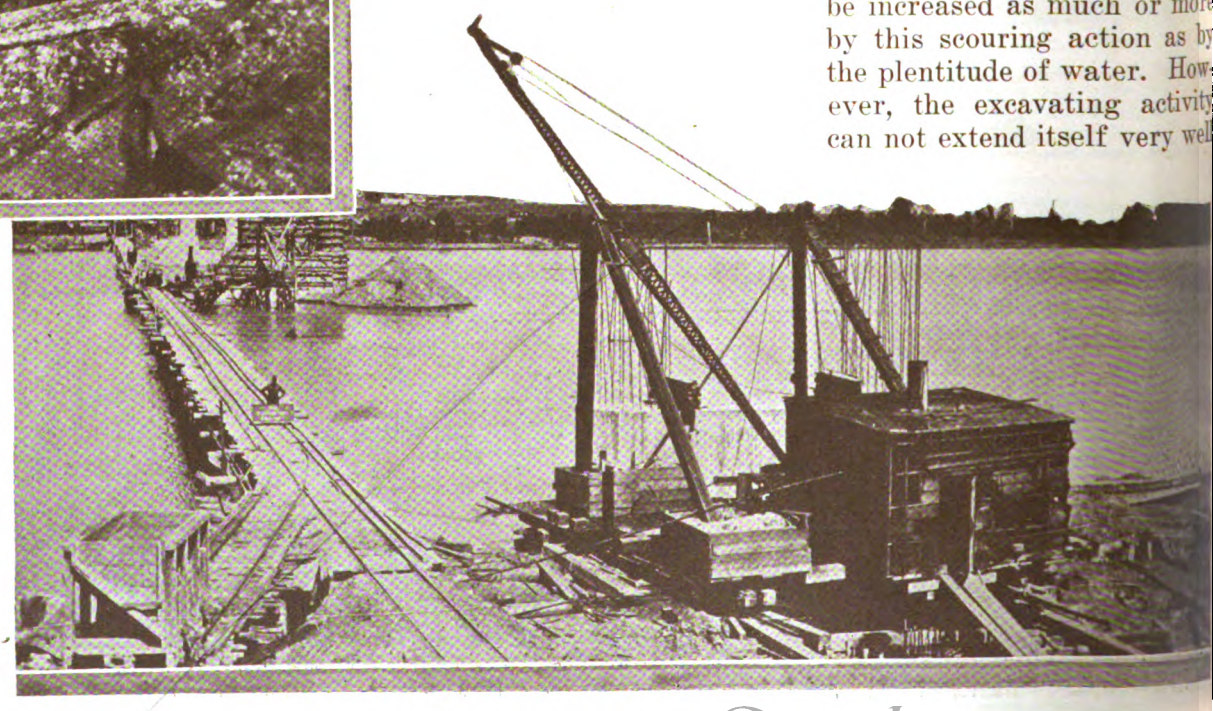
THE transcontinental highway from the East is, in North Dakota, known as the Red Trail. This notable road crosses the Upper Missouri at Bismarck. It would perhaps be more correct to say that the highway came to the bank on the east side of the river and resumed its course on the west side. In the days gone by, various methods of getting across were employed. If the traveler arrived in his auto in the summer time, he could generally cross by means of a ferry. But if the wind was high or if the river was at flood, then the ferry would as likely as not be out of commission for the time being. The passage across could ordinarily be effected in the winter time over the ice. There is a bluff on one side and anywhere from one to three miles of river bottom on the other. The river itself is far from constant in its width, the distance across varying from 1500 to 3000 feet.

As a matter of fact, the bridge crossings are not numerous and are said to be costly. However, a highway bridge is now about completed which connects the capital of the state, Bismarck, with Mandan, on the opposite side of the stream.

In this region, the Missouri flows in a stratum of silt. This is disturbed at the flood seasons, a large part of the material being caught up and carried on. As the speed of the river declines at the close of the flood, other silt is deposited. The new locations of deposit do not altogether coincide with the locations from which the old silt was removed. The effect is the same as if the river bottom had had its silt shifted. The forgoing phenomena are due largely to the fact that when the flood begins the river digs down into its bottom of silt. The depth may at times be increased as much or more by this scouring action as by the plentitude of water. However, the excavating activity can not extend itself very wel

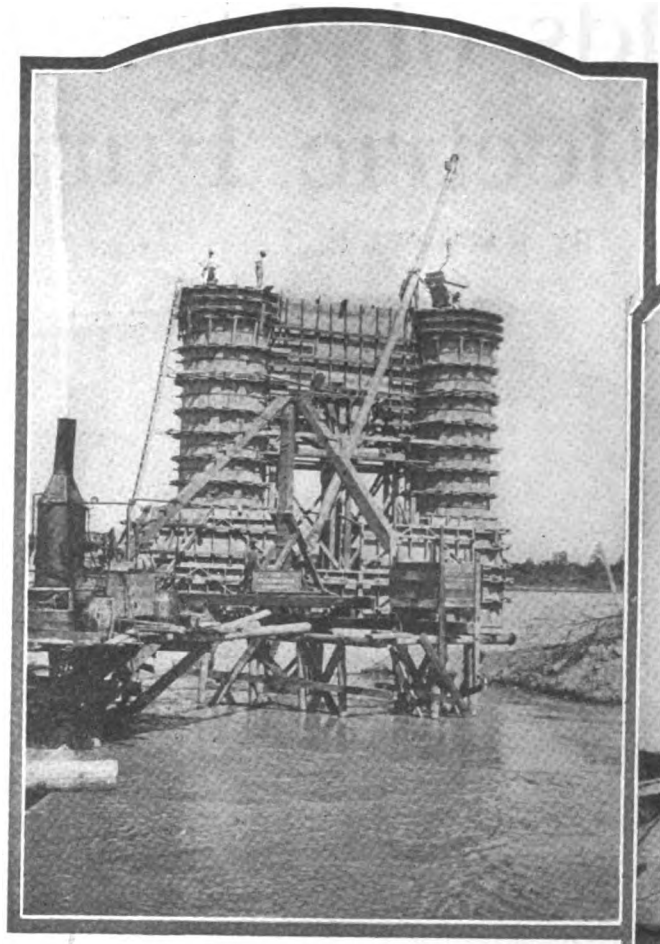


Above—sinking a caisson for one of the piers, in winter weather. Difficulty was experienced, owing to the inequalities of the clay river-bed.

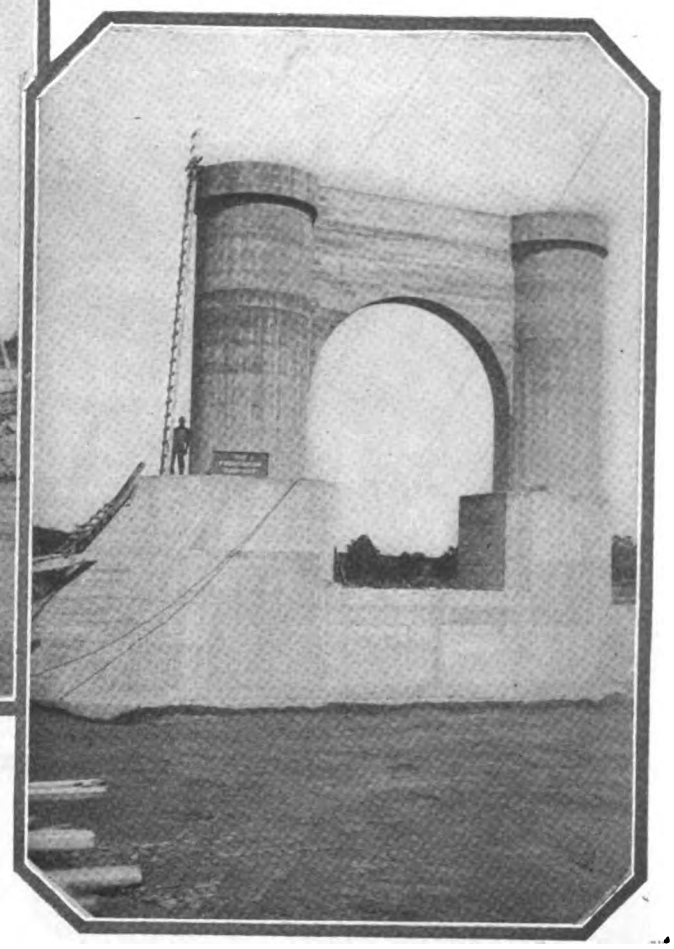


Temporary bridge and track for bringing concrete, etc., to the piers under construction. Total length of the finished bridge is 2428 feet.

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Bridge pier under construction, concrete forms still in place, as well as falsework at the pier base.



At the right—one of the completed piers, photo taken in 1921, before spans were begun.

further than the top of an underlying stratum of shale clay. This stratum lies at depths varying from 30 to 90 feet below the level of the water when the river is at a minimum stage.

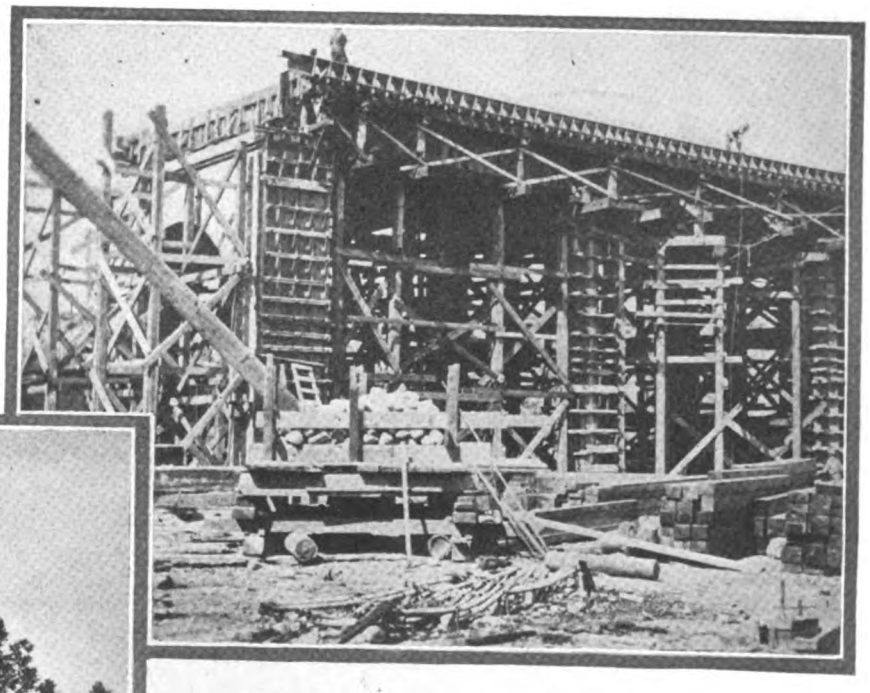
This underlying clay, limiting, as it were, the scouring action of the river, constitutes the uppermost stratum in which it is safe to place the support of the pier foundations. If the foundations are set higher, they will be exposed to the hazards of the grinding action produced by swiftly moving water carrying solid material.

The site selected is perhaps a mile downstream from another bridge, that of the Northern Pacific Railroad. This railroad bridge does not, it seems, have the best of locations, since a clay bank is already giving trouble to the railroad in connection with the east pier. On the other hand, the clay stratum which underlies the silt bottom is at a somewhat deeper level at the site of the Red Trail Bridge. Still, the site is on the direct route between Bismarck and Mandan, and this is a matter of economic value.

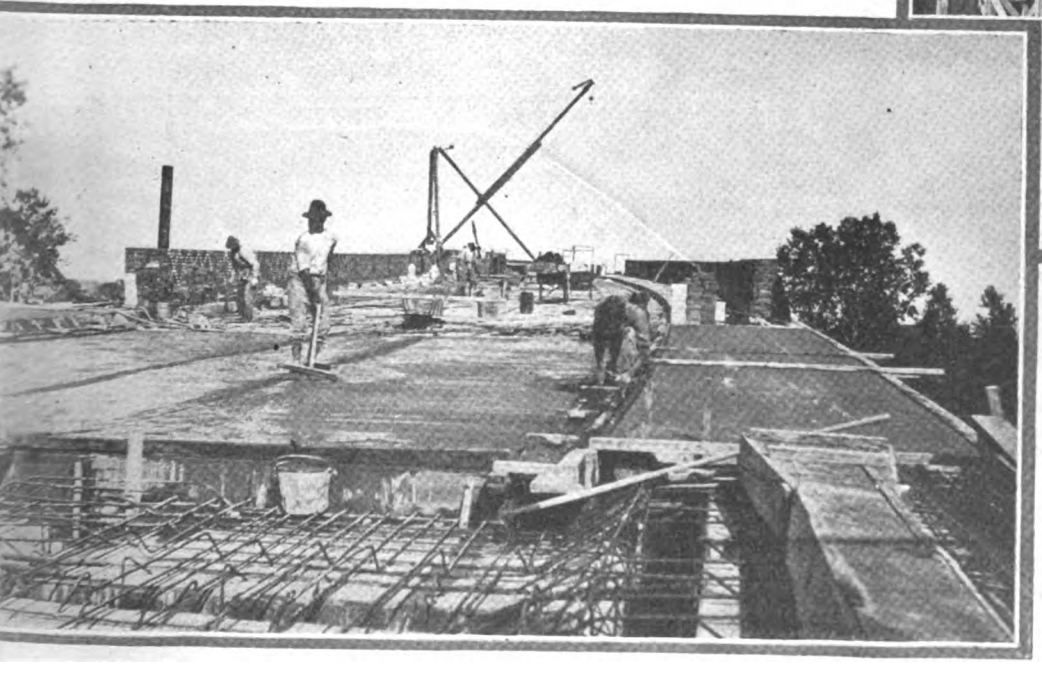
The bridge itself consists of three considerable spans, each measuring 476 feet, center to center. There is a concrete approach 400 feet long on the east, and one 600 feet long on the west. It will thus be seen that the total length of the structure is about 2428 feet. There is a central roadway 27½ feet wide and two side footways each 6 feet wide.

For some reason, the silt above the underlying clay stratum contains relatively few boulders and logs. Just why this should be is not altogether clear. Perhaps the best explanation is that the silt bottom

(*Continued on Page 53*)



Construction of the eastern viaduct approach to the Red Trail Bridge.



Laying the permanent roadway on reinforced concrete base. There are two foot-ways, and a vehicle roadway 27½ feet wide.

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New Fields of Usefulness for the Electric Furnace

By Raymond F. Fletcher

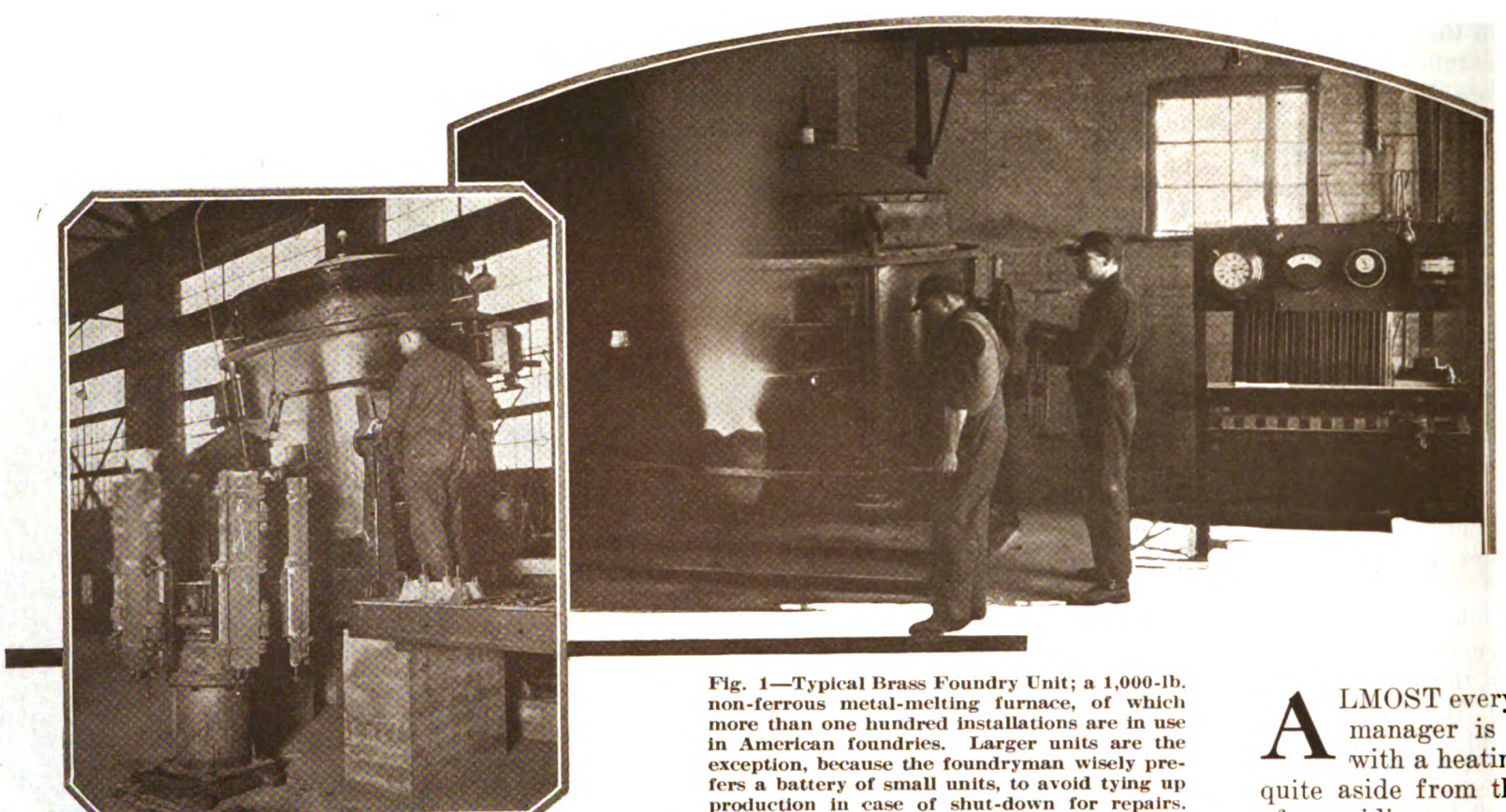


Fig. 1—Typical Brass Foundry Unit; a 1,000-lb. non-ferrous metal-melting furnace, of which more than one hundred installations are in use in American foundries. Larger units are the exception, because the foundryman wisely prefers a battery of small units, to avoid tying up production in case of shut-down for repairs.

Fig. 2—A One Ton Rolling Mill Furnace, pouring the metal directly into rolling mill moulds; which does away with crucibles and minimizes hand labor.

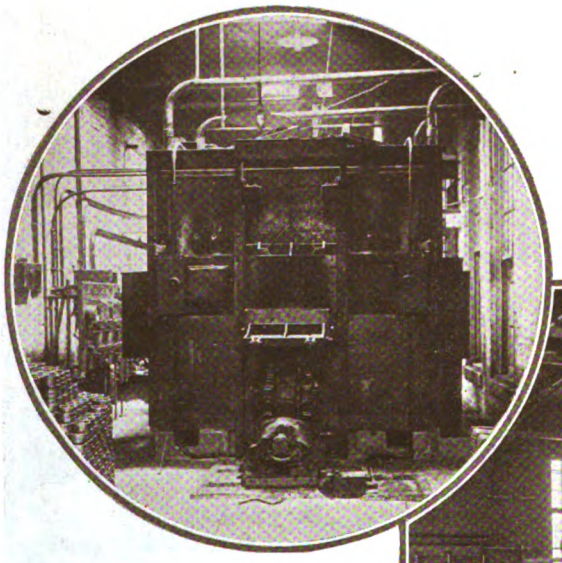


Fig. 3—At the Left: A typical Heat Treating Unit. This furnace is hardening ball races for bearings. Completely automatic equipment carries the material through hardening, quenching and drawing operations, without manual labor.

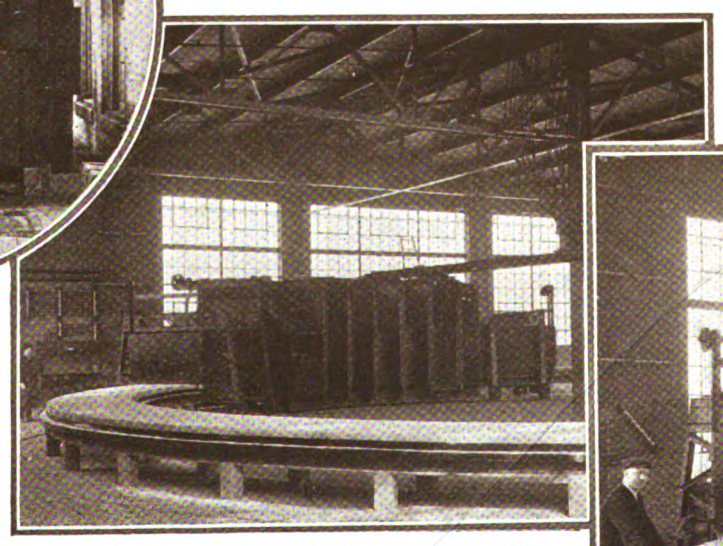


Fig. 4—At the right: Enamelling Equipment, showing the car furnace and the circular table over which it travels. Details are shown in succeeding illustrations

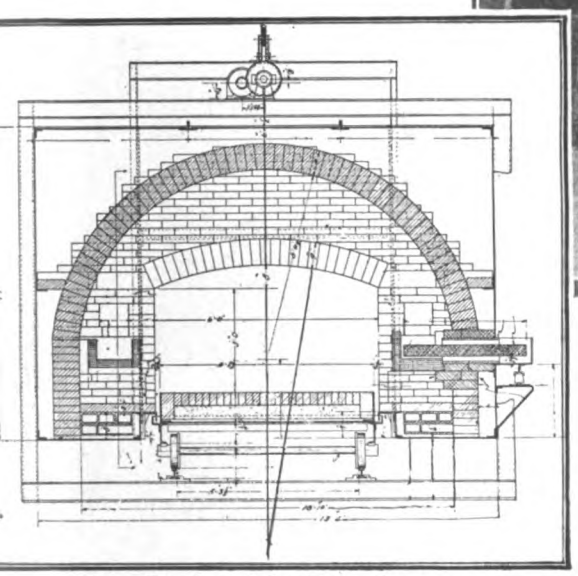
Fig. 5—At the right: Enamelling Equipment, showing how the ware to be enamelled is placed on the stationary circular table.



ALMOST every industrial manager is confronted with a heating problem quite aside from the question of providing warm and comfortable working quarters. If his plant melts metal of any kind, hardens dies, knives or tools, or subjects castings to any sort of heat treatment, he is interested in that very modern science of industrial heating which, by substituting electricity for other fuels, gains a degree of control heretofore unattainable in furnace equipment. The adoption of electricity in diversified industries has progressed rapidly, and each new field of usefulness concerns both the men directly connected with that industry

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A—Below: This cross section shows e two rectangular carborundum annels or troughs, on either side of e heating chamber. The essential rinciple remains the same in the circular melting furnace.



Cross Section of Car Type Furnace

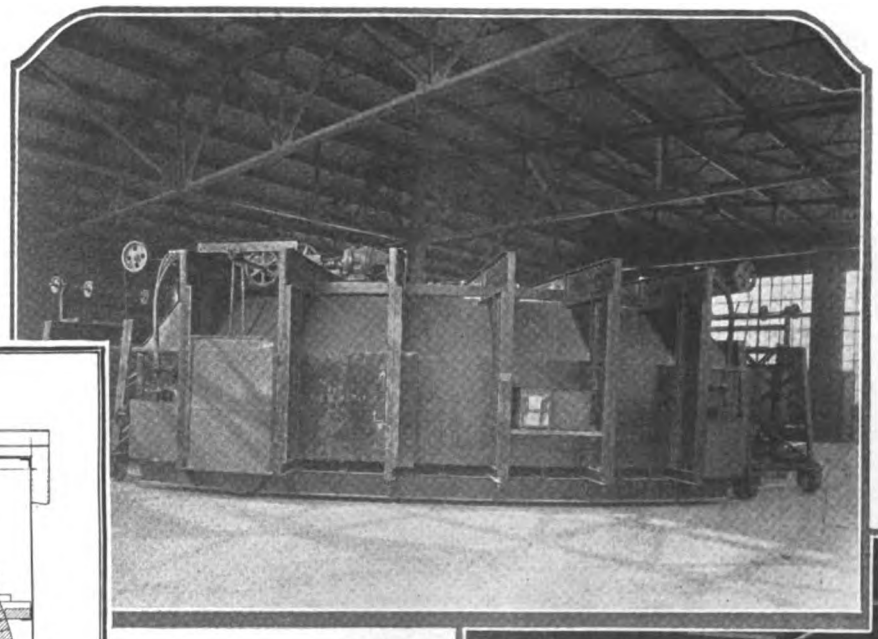


Fig. 6—At the left: Enamelling Equipment, showing the furnace car itself, which travels at regulated speed over the circular table on which the parts are placed; the speed being regulated according to the work, and the degree of heat likewise.

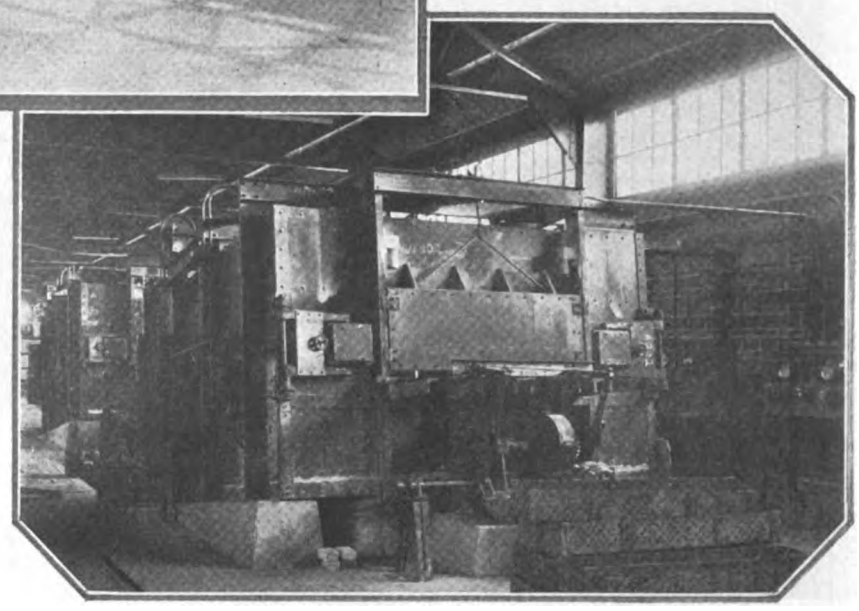


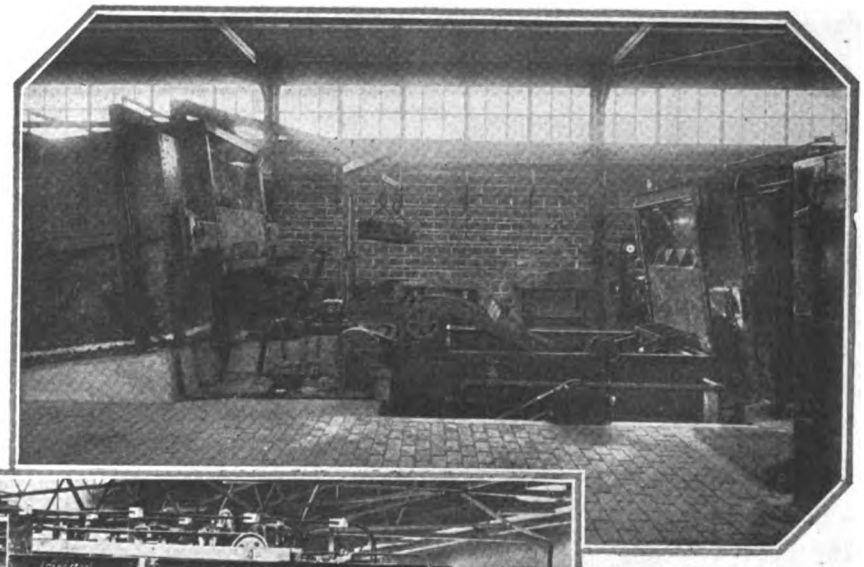
Fig. 7—At the right: Automatic Unit for Heat Treating Automobile Parts. The material is loaded into pans which are placed on the charging platform by motor-operated pusher.

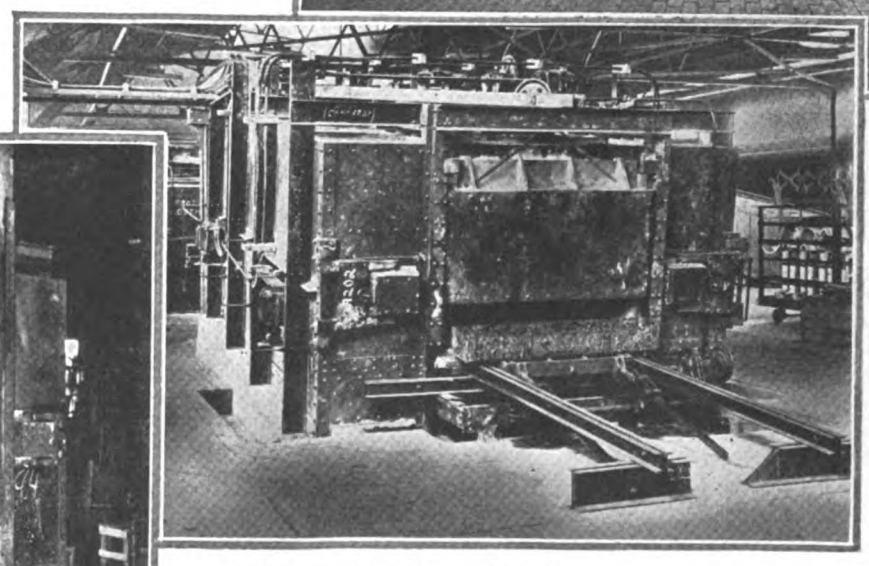
nd those progressive en- neers in other fields who see such development possibility applying the same principle their own work.

Beyond doubt, the United tates leads the whole world in e electric furnace field, both to the number of electric its in service, and also as to e diversity of application. In e whole world there are obably 1,000 furnaces melt- g electric steel, 300 melting pper zinc aloys in foundries, 0 casting metal in rolling lls, and fully 100 serving in emical processes, doing high nperature baking, and mak- g electrodes. One hundred ier units are employed in at treating and annealing, sides a large number used

Fig. 8—At the right is shown the automatic transfer and quenching operation of the automatic heat treating unit. The time cycle is so arranged that the time necessary for the pan to pass from charging door to discharge end of furnace is exactly right for the designated heat treatment.

Fig. 9—Below, at the right, is shown the discharging end of the automatic heat treating furnace.





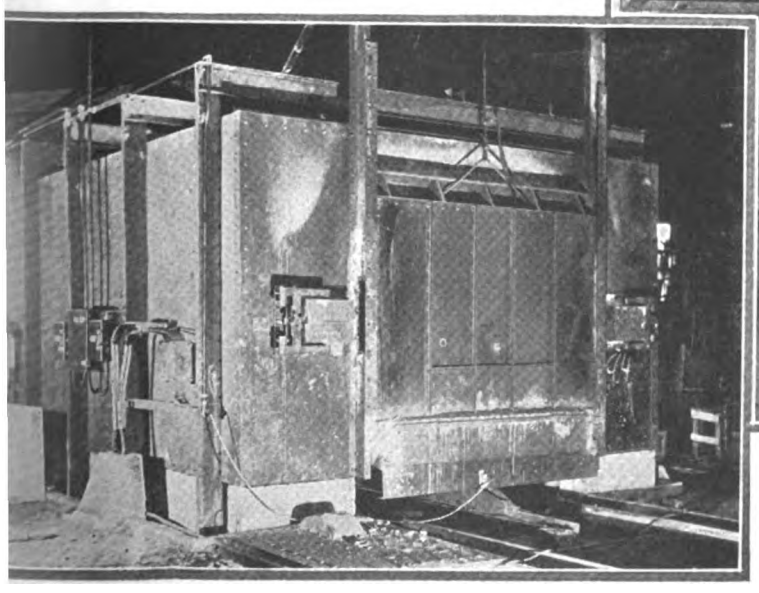


Fig. 10—At the left: the Car Type Furnace for Manganese Steel Castings, which eliminates the heavy breakage formerly met with due to uneven heat treatment before quenching.

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Fig. 11—A pit Type Crucible Furnace, capable of holding two number 40 crucibles. For precious metals, the danger of loss in handling is reduced to a minimum.



Fig. 12—A ferro-Manganese Melting Unit, especially valuable because this alloy cannot be held in an ordinary furnace without loss, being extremely volatile. The resistance furnace, with its sealed melting chamber and non-oxidizing atmosphere, does away with this difficulty.

Fig. 14—Below is shown a hot charge from the car furnace (Fig. 10) ready to be transferred to the water quench.

Fig. 13—Below: Pouring silver into molds, from crucible heated in the furnace shown in Fig. 11.





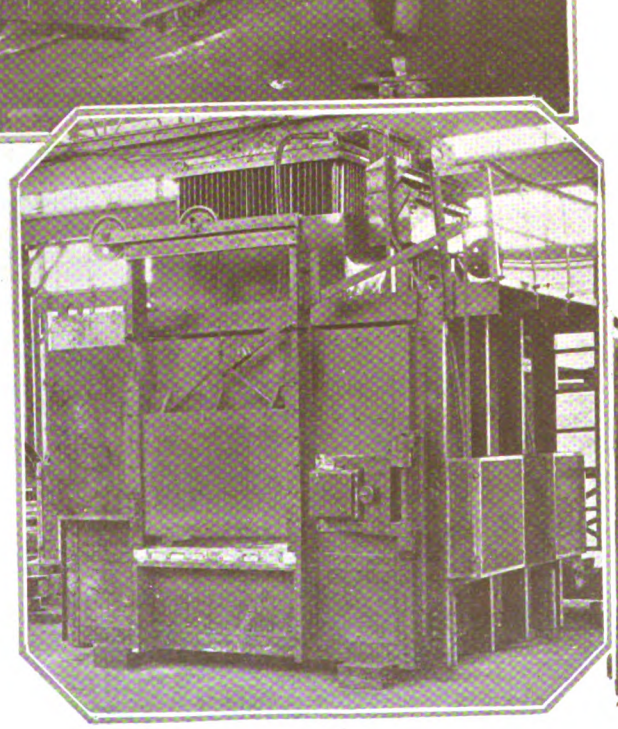


Fig. 15—Portable Electric Furnace, for heating automobile parts for stamping. A crane moves the furnace where required.

for laboratory work for japanning, and for other low temperature operations. Of the grand total, fully 1,000 units are in service in the United States.

There are but four fundamental types of electric furnaces, differentiated by their method of heat generations: the arc furnace, the granular resistor, the induction type, and the nichrome ribbon unit. The arc furnace produces heat by the contact of carbon electrodes, while in contrast, the resistance type has its heat source in troughs of carborundum, packed with granular carbon which is brought to incandescence by the passage of current through it. Of the other two types; the induction furnace has a vertical ring of molten metal which acts as conductor, and the nichrom ribbon unit transmits its he energy through series of stri of nickel chromium.

While all these types ha met a wide application, the r sistance type furnace undoub edly has successfully enter more diversified fields of i dustry than any of the othe The illustrations in this ar cle are all typical resistan type furnaces, but it must borne in mind that each of t four classes of electric fu naces is rapidly broadening i field usefulness, and eve month develops some succes ful application which w scarce even dreamed of a fe years ago.

In the resistance type fu

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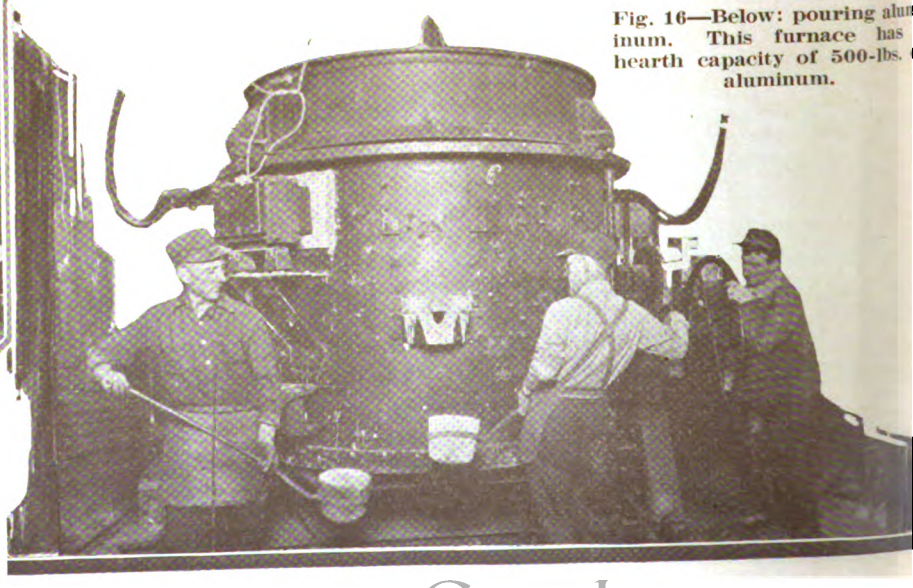


Fig. 16—Below: pouring alum inum. This furnace has hearth capacity of 500-lbs. aluminum.

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Pioneer Work in Developing the Radio Telephone

By Jerome J. Green

ONLY twenty-three years ago the newspapers of the whole world gave much space to an announcement. Mr. Marconi the pioneer radio man, had succeeded in sending signals from France to England across the channel a distance of 34 miles without any material connecting medium. This was called wireless telegraphy and with the devices then available it was really a remarkable accomplishment.

The American newspapers eagerly printed reports of experiments in telegraphing without connecting wires, that were carried on at educational institutions with the apparatus found in the science laboratories. The successful sending of signals a distance of a few miles was considered of sufficient importance to merit headlines on the first pages of our daily papers. All this indicates that people have been much interested from the very first in the possibilities of this almost uncanny means of transmitting messages.

Less than ten years later the ship on which we crossed the ocean was equipped for sending and receiving wireless messages, a newspaper was printed each day on board giving the latest news of the world. Most of the larger passenger carrying ships were similarly equipped and many serious losses of life and property were prevented by the S. O. S., sent out by ships in distress.

In London the triple antennae suspended above the roof of the Admiralty building, the headquarters of the British Navy, and suitable equipment on the battleships made it possible for the head of the Navy department to communicate with the officers on the ships at sea hundreds of miles away.

In Paris Prof. Branley, the inventor of the coherer, the first detector used by Marconi in his earlier experiments, with considerable pardonable pride sent the patriotic message "*Vive la France*" from one room to another where it was received by an improved coherer and recorded on a tape in printed dots and dashes, when we visited him at the University of France in January 1908.

The great improvements in both sending and receiving devices during the first decade of wireless work had made it possible to send messages from Europe to America across the Atlantic ocean. Long distance stations were being constructed and much patient research work was being done to improve the sensitiveness of the receiving sets and to increase the power of the sending stations.

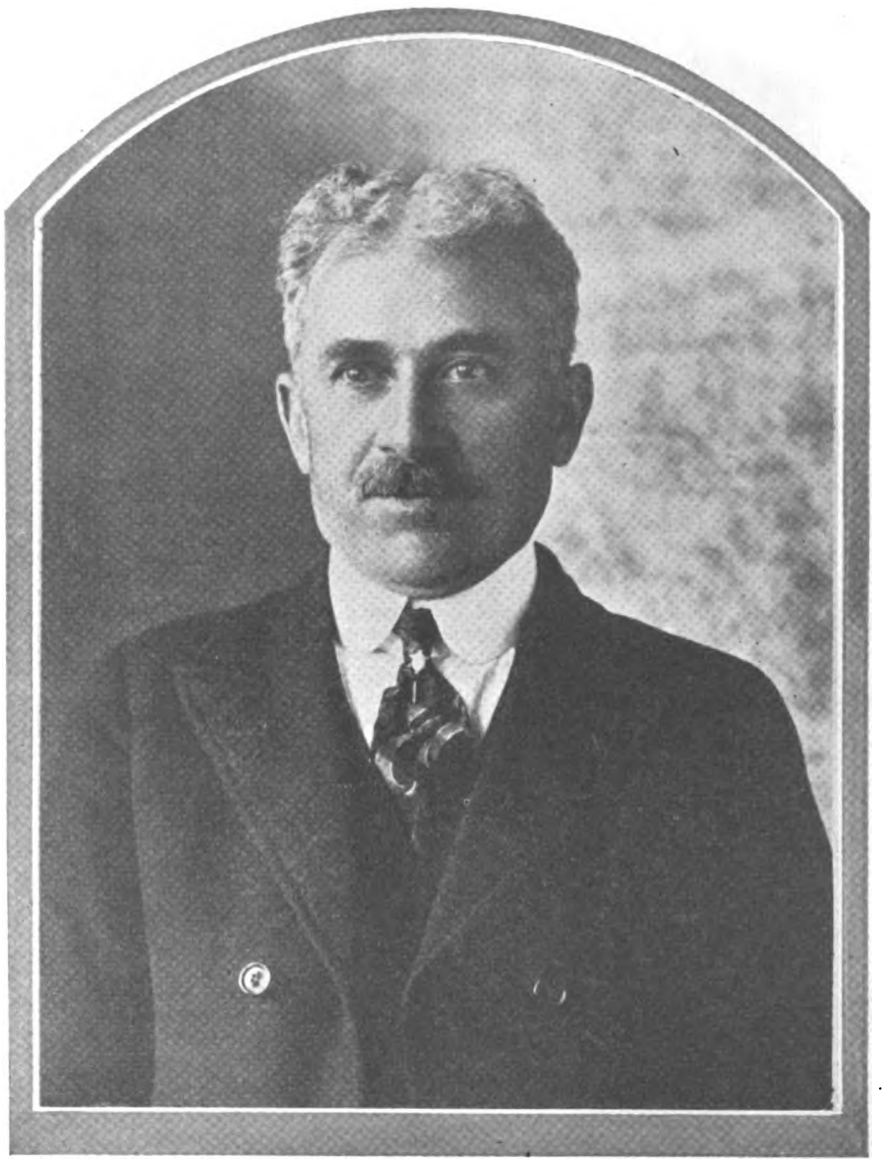
From this time rapid strides were made in the improving of the detector, the essential part of the receiving device. The little tube of nickel and silver filings called the coherer by its inventor had been replaced by thermal devices, electrolytic cells and many other interesting contrivances but all these were rendered obsolete by Fleming's great discovery of the vacuum valve which in its improved form, known as the audion or by other trade names, has made possible the recent great advance in the transmission and reproduction of audible sounds by the radio telephone.

It was this device used as an amplifier at the great U. S. station at Arlington near Washington, and as a detector at Honolulu 5000 miles away over land and sea, that made it possible for a person at Honolulu to recognize the person who spoke before the receiver at Arlington by the tones of his voice. This historical test of the radio telephone was made in 1915.

After this remarkable demonstration not much long distance work was attempted but all efforts were directed toward perfecting devices to use in the great world war which was now going on. We heard of radio directed torpedoes and ships steered by radio impulses, as well as many other interesting and useful applications of radio transmission.

At Rockwell field at San Diego at the close of the war the radio department of the air service occupied a large building where several officers were working out plans for using the radio telephone to communicate with a station on the earth from air planes high up among the clouds. We were much impressed when we heard the voice of one of the officers who

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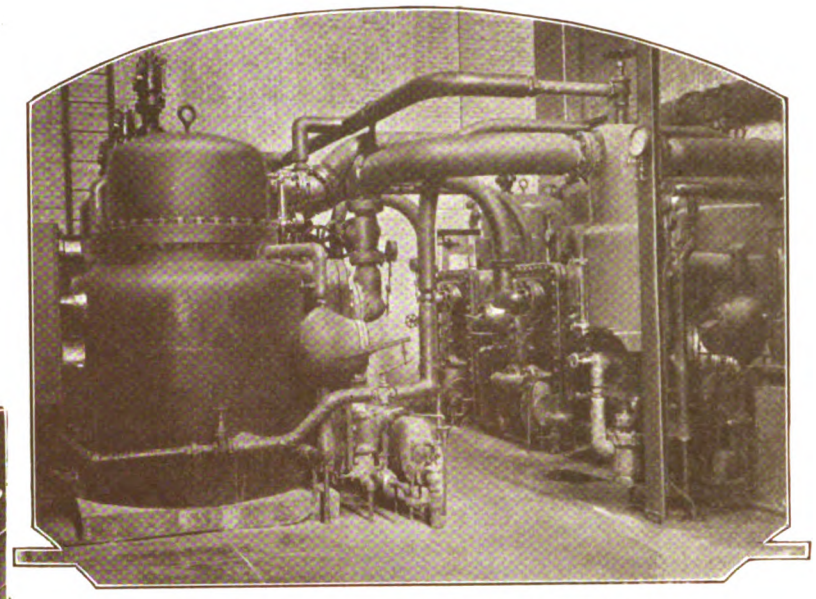
Jerome Joseph Green was born near Somerset, Ohio, in 1865. Graduating from Ohio State University as a mechanical engineer in 1893, he studied at the University of Paris and at the Technische Hochschule, Berlin, in 1907-8. After important work in installing and testing electrical apparatus at the Chicago Exposition (1893) and at the Atlanta Exposition (1895), Mr. Green became chief instructor in the National School of Electricity, Chicago, and later (1895-1915) Professor of Physics and Engineering, University of Notre Dame. He has been head of the technical department and director of vocational education at the Junior College and High School, San Diego, California, since 1915.

Mr. Green conducted important experiments in wireless telegraphy in April, 1899, at Notre Dame, and was one of the pioneers in Radio in this country. He is a member of the San Diego Teachers' Association; A. A. A. S.; International Electrical Congress at St. Louis (1904); member of the Aerial League of America, and lecturer on aerial navigation.

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Water Problems of the Boiler Room

The Feed-Water, Exhaust Steam, Feed-Water Cycle

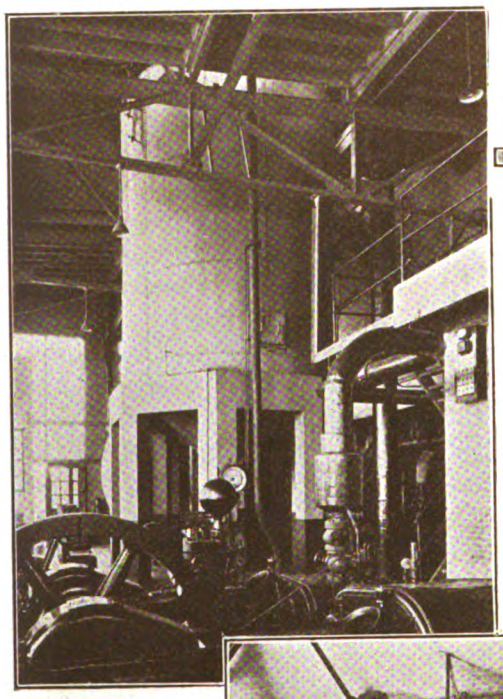


Clean boiler flues mean efficiency in boiler operation, incrustations of scale act as heat insulators and progressively decrease boiler efficiency. These incrustations are due to chemical and other impurities in the feed water. Above is shown a relatively new feed water purifying method. The evaporation by boiler steam eliminates these impurities before the feed water enters the boiler.

Griscom-Russell Co., 90 West St., New York.

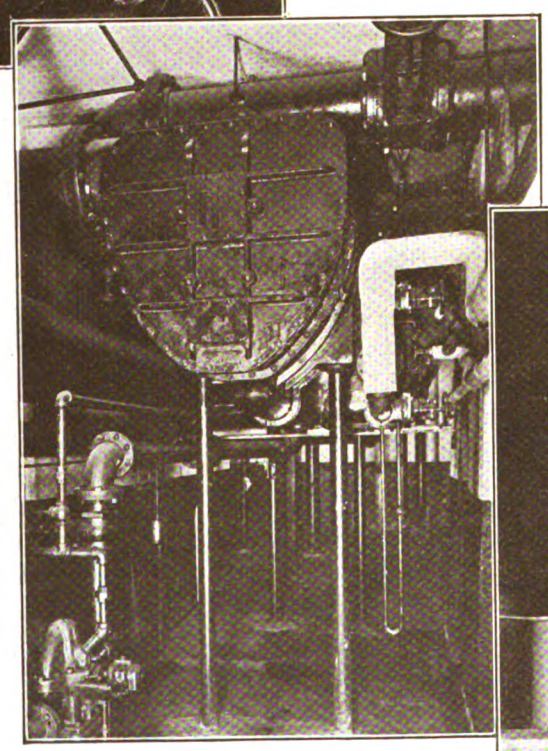
Below is a water softening installation serving 3300 horsepower at the plant of the Central Products Co. of Detroit. It has a capacity for softening 14,400 gallons of raw water and for heating 18,000 gallons per hour of condensed returns. These boilers operate from 200 to 250 per cent continuously and frequently at 300 per cent peaks.

H. S. B. W. Cochrane Corp., Philadelphia, Pa.



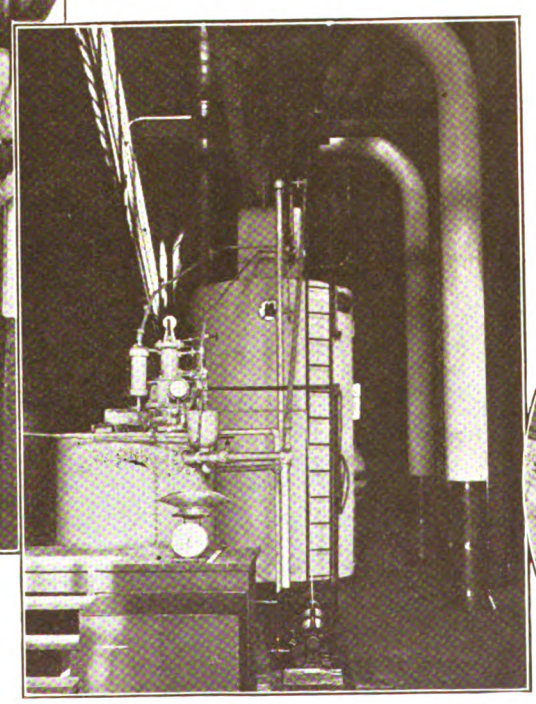
Louisville Light and Power Co. uses this chemical hot process softener (below) to serve their 4000-horsepower boiler plant. No tubes have been lost since the softener was put in operation, and although high ratings have been carried on the boilers there has been no forming or priming.

H. S. B. W. Cochrane Corp., Philadelphia, Pa.



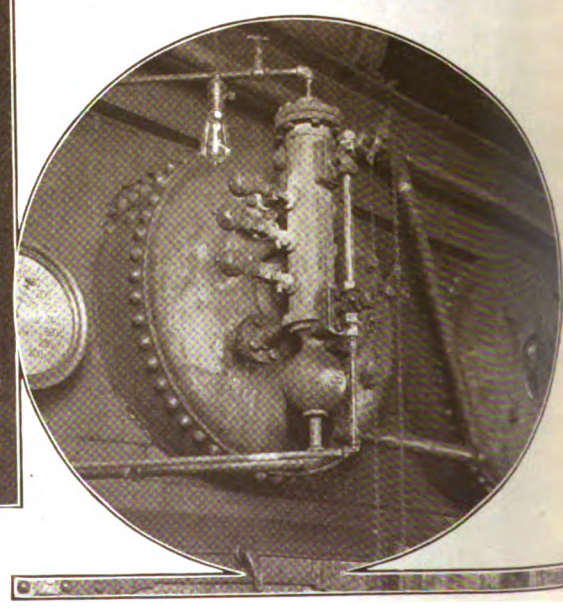
There are many styles and types of condensers for condensing exhaust steam before it is returned to the boilers. A new type is shown above installed in the power house of a large automobile plant.

Ingersoll-Rand Co., 11 Broadway, New York.



Practically all of the new power plants have safety water columns installed from the start. Here is one, however, that has been in use for seventeen years in the power plant of the White Motor Co., Cleveland.

Reliance Gauge Column Co., Cleveland, Ohio.

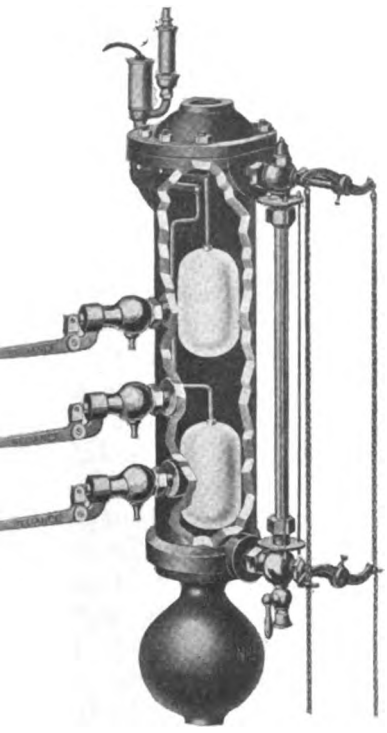


SIR ROBERT HADFIELD recently presented a paper before the Institution of Civil Engineers, in the course of which he estimated that in a single year (1020) the world lost twenty-nine million tons of steel through rust alone—$3,500,000 worth of corrosion of iron and steel in one year, without calculating the other metals! But the author admits that the major portion of this loss is impossible to prevent at the present stage of our knowledge regarding the causes and methods of preventing corrosion.

A sizeable percentage of this corrosion occurs in connection with steam power generation: in steel stacks, iron piping, and perhaps most of all in boiler shells and tubes. In the last-named case, not only corrosion, but incrustations of scale add to the difficulties: interfering with heat transmission through the tube walls and shortening the life of the tubes themselves.

Just as the chemist helped the engineer to determine the how and why of faulty draft regulation by treating combustion as a *chemical* problem, and

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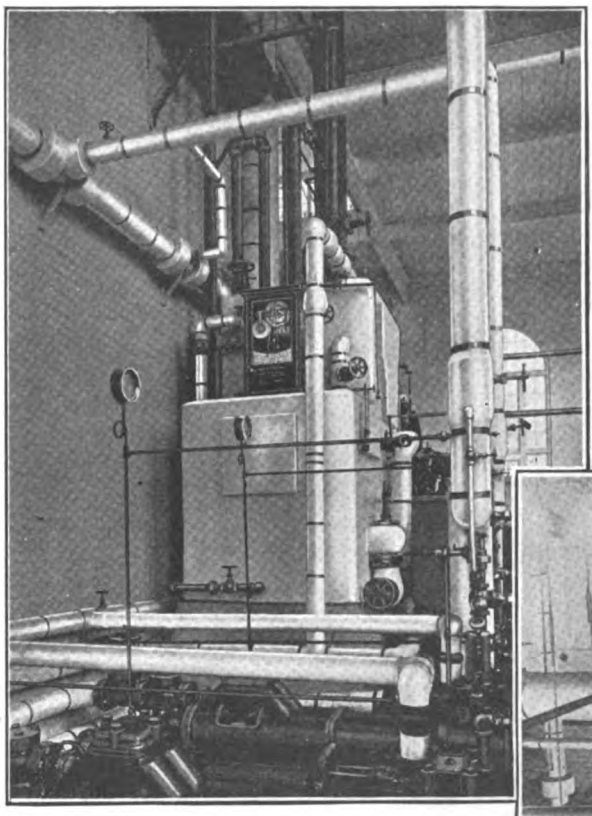
The safety water column is one of the older mechanical improvements in boiler practice, but nevertheless recognized as essential today. It eliminates the danger of explosion, warns of high as well as low level, and saves fuel by helping to maintain constant pressure. This illustration shows the "insides" of a safety water column.

ance Gauge Column Co., Cleveland, Ohio.

rnishing a means of determ-
ng correct flue-gas composi-
n—so, on the problem of pre-
nting boiler scale, again the
emist has shown his worth.
it this doesn't mean that the
dern power plant engineer
s to master chemistry; it
rely means that he must, if
is onto his job, take ad-
ntage of the work the chem-
s have done in showing how
le can be eliminated.

Once the water has been con-
ted into steam in the boiler,
layman would think the
per thing to do would be to
p it as steam and return it
the boiler in that form to
e its pressure raised. This
uld of course be ideal, since
would conserve all the excess
t devoted to converting
ter into steam in the first
ce. But, being a physical
ossibility, it is something
practical engineers don't
a dream about. Instead,
e they know that only an
gnificant percentage of the
of the steam delivered to
engine is actually utilized
power—in fact, as much as
of this heat is discharged
he exhaust steam—they try
et as much use out of this
as possible in the process
condensing the exhaust
m for boiler feed.

he installation at the

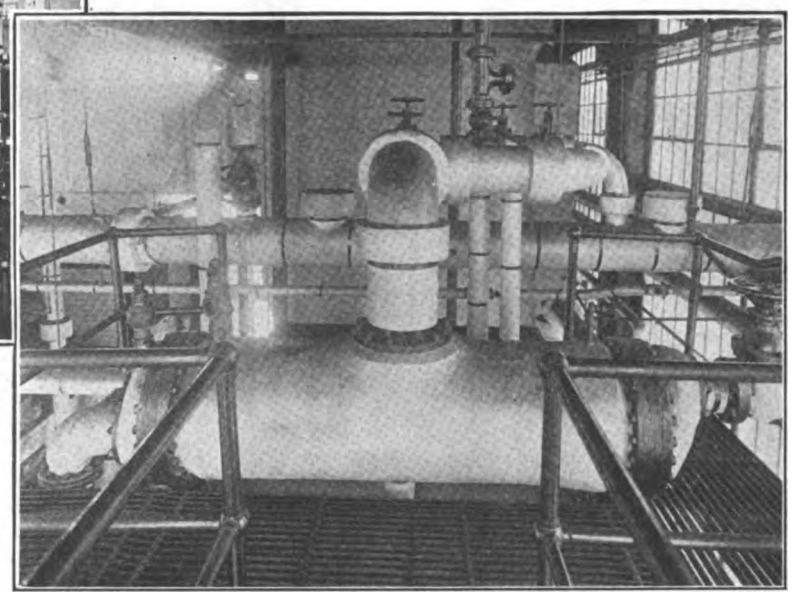


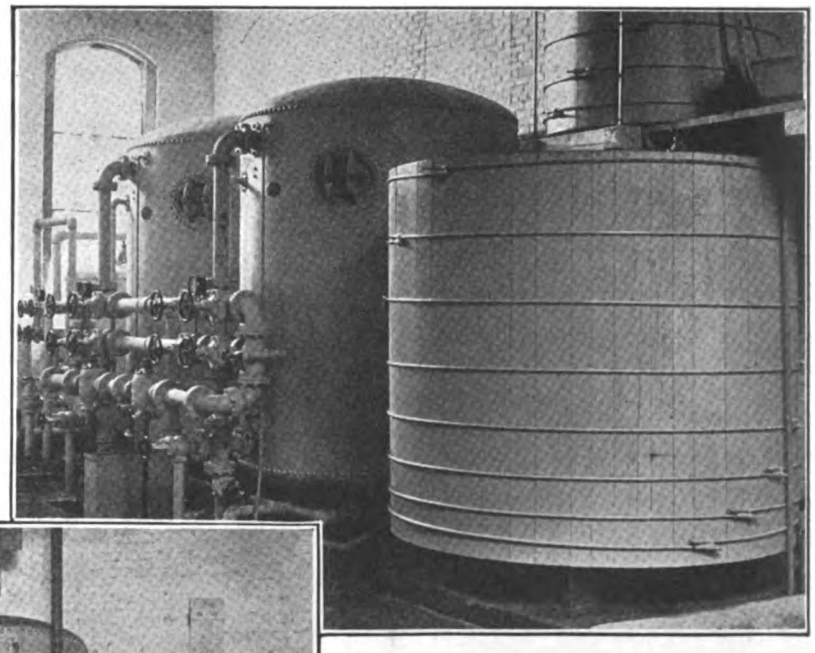
Just as necessary as measuring the coal consumption is the measurement of the feed water which gives the pounds of steam produced per hour. Here is a combination heater and feed water meter at the Duplan Silk Co., Dorranceton, Pa. This apparatus (above) utilizes exhaust steam to heat the feed water to 212 degrees, at the same time accurately measuring it.

H. S. B. W. Cochrane Corp., Philadelphia, Pa.

One way to get the most out of steam heat units after they have served for generating power, is to use the exhaust steam for heating purposes. Here is a heater which makes use of exhaust steam by transferring its heat to water circulating through the heater. This particular installation (below) is owned by the American Fabric Co., Bridgeport, Conn., and in addition to heating the plant during the cold season it also serves a group of dwellings.

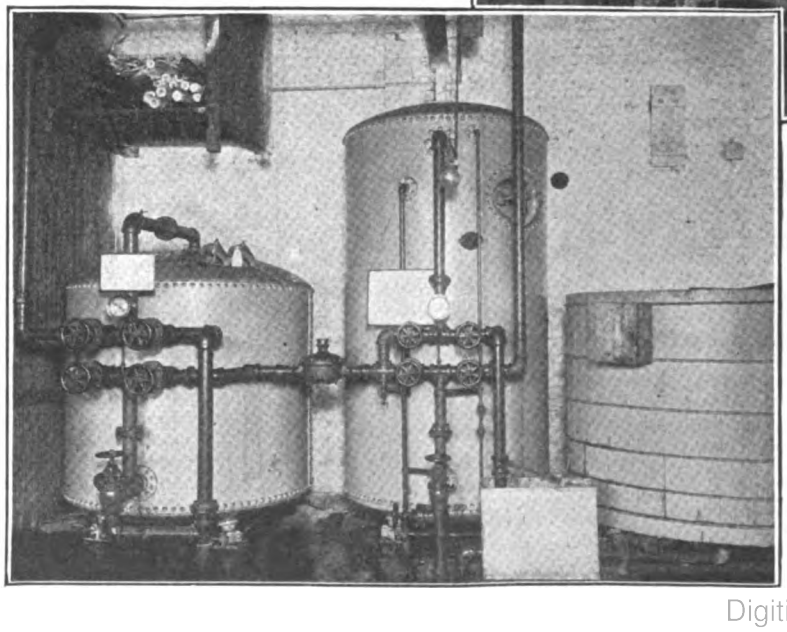
Alberger Pump & Condenser Co., 140 Cedar St., N. Y.





Here at the right are two water softeners installed in the boiler plant of a large textile mill serving 2200-horsepower. This installation is said to have saved $3600 annually for tube replacements alone in addition to other savings.

The Permutit Co., 440 Fourth Ave., New York.



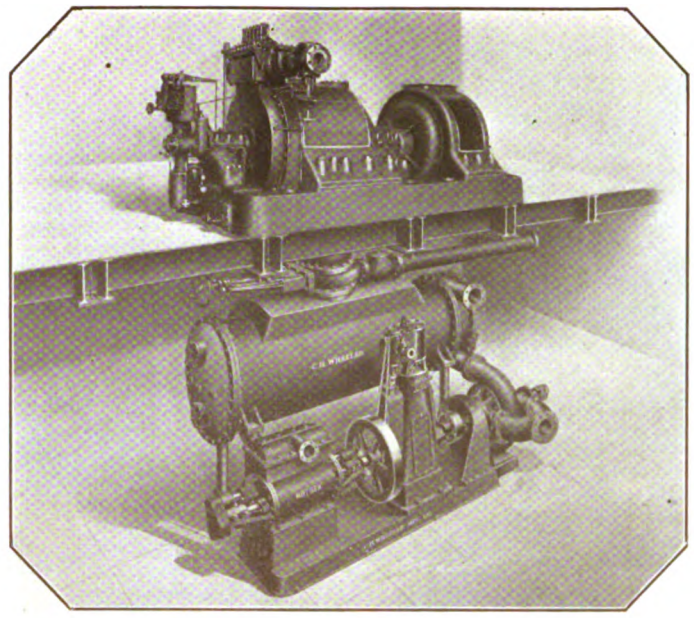
A small clarifying filter and water softener is shown at the left; installed to serve four 120-horse power returned tubular boilers. It is stated that these boilers have not had to be cleaned for the last six years.

The Permutit Co., 440 Fourth Ave., New York.

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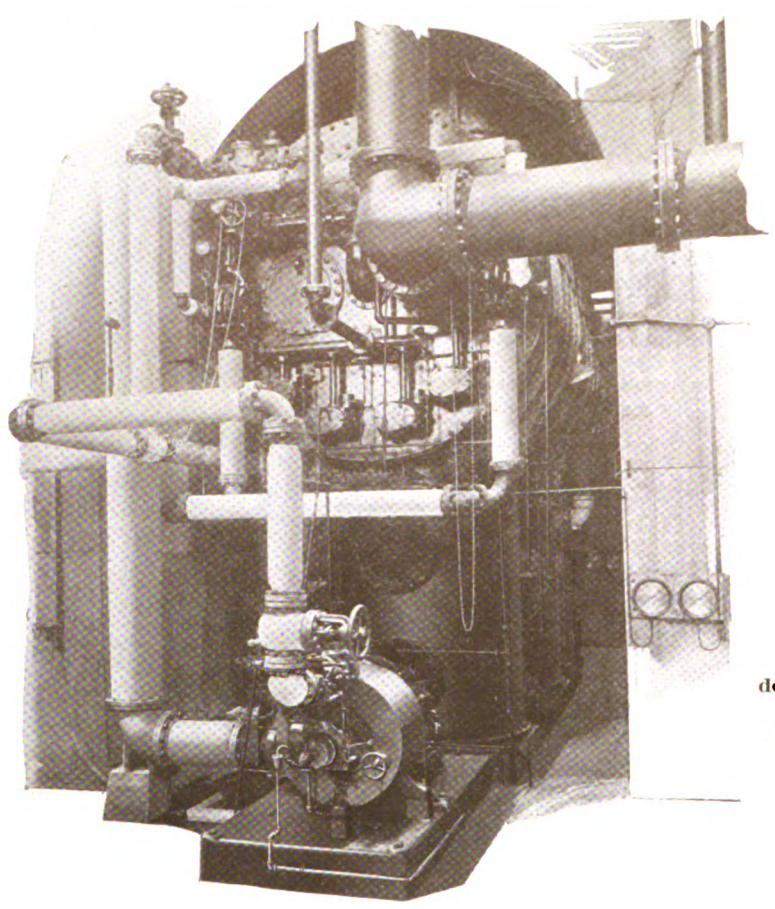
A typical modern installation showing the surface condenser connected to a steam turbo generator is shown at the right.

C. H. Wheeler Mfg. Co., Philadelphia, Pa.



American Fabric Company, Bridgeport, illustrated at the top of page 23, is especially interesting in connection with utilizing heat from exhaust steam, in that this heat is used both within the plant and for heating dwellings outside. In other words, just because a plant *itself* cannot use all its exhaust heat is no reason for wasting it.

In the very best operation of a steam power plant there is—speaking from an economic standpoint—an appalling waste of the heat units contained in the fuel; only fifteen to seventeen per cent of the fuel heat being converted into useful energy. Taking in all of our industrial power plants, the average thermal efficiency is probably nearer seven or eight per cent. When we realize that the *practically attainable* results are just about twice as good as the *actual average* results—or, putting it in another way, that we are paying almost twice as much as we should pay for our total steam power—it is about



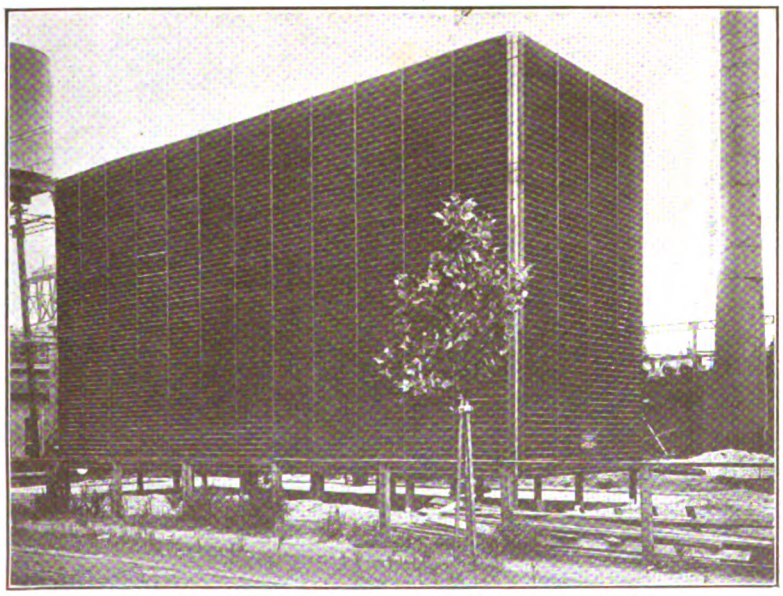
This illustrates a type of condenser known as the "jet" in which the steam gives up its heat and condenses by direct contact with the cooling water.

C. H. Wheeler Mfg. Co., Philadelphia, Pa.

time we should collectively and individually do something about it.

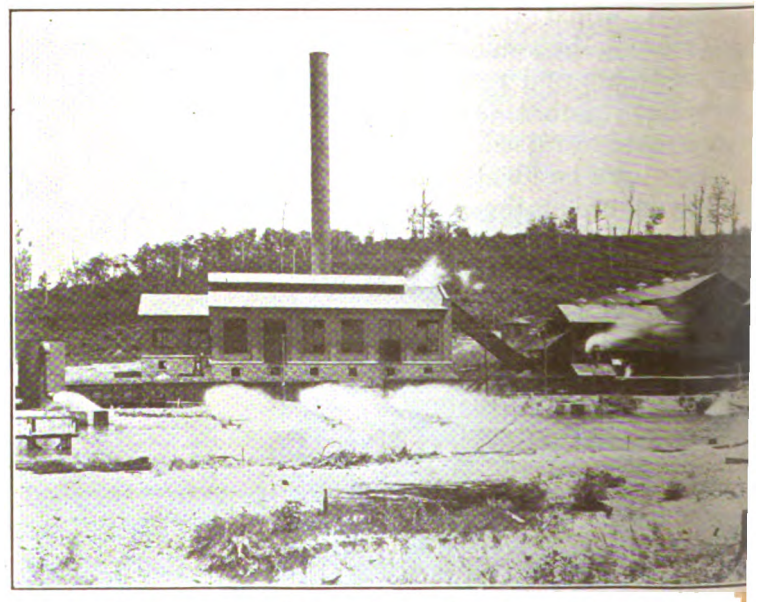
The preventable losses in steam generation are distributed among some half-dozen major classifications. It is only by going all along the line, eliminating one after the other, that the individual power plant can attain—and maintain—the efficiency it *must* have, to cope with present day fuel costs.

When your automobile was new, remember how you used to keep it oiled up, pay attention to every knock, investigate every device that held out hope of more miles per gallon or more miles per tire? It is a pity we can't assume a similar state of mind with regard to our industrial power plants. The vast majority of them as a matter of honest fact, are in much the position of an old automobile—we've become so used to the knocks and squeaks and grinds and leaky valves that it takes some great crisis to wake us up to the need for repairs and better handling. It may be that the present coal strike will, in the end, prove something of a blessing in disguise by waking us up to what we can and should do.



If steam could be returned to the boiler without being condensed and be simply reheated and raised to a higher pressure, an age-old but impossible inventor's dream would be realized. Unfortunately steam has to be condensed into water and this requires plenty of cooling water for that purpose. A cooling tower is commonly used for this purpose when the plant is not within a reasonable distance of copious natural water supply.

C. H. Wheeler Mfg. Co., Philadelphia, Pa.



Laymen sometimes think that these attractive looking sprays are made to decorate the landscape and not for utilitarian purpose. They serve the same purpose, however, as a cooling tower although by different method. That purpose is to cool condensing water by means of contact with the air. The installation shown above is the spray pond of the Ebensburg Coal Company, Ebensburg, Pa.

Spray Engineering Co., Boston, Mass.

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J. A. ZEHNTBAUER, who, in five years became President and principal stockholder in the JANTZEN KNITTING MILLS, manufacturers of the famous *Jantzen Swimming Suit*, and treasurer of another successful company.

Why wait 20 years to be a President?

HERE'S A MAN WHO WENT TO THE TOP IN FIVE

THE point which the Alexander Hamilton Institute repeats again and again is simply this: that the man who finds a way to shorten his path to success by five years, or ten years or fifteen, is actually putting into the bank from $35,000 to $75,000 or more in cash.

Succeed at fifty and you have a certain number of high-salaried years ahead of you before your work is done; succeed at thirty-five, and you have fifteen additional high-salaried years. In other words the mere money value of executive training is so great that surely you owe it to your future and your family to investigate at least.

The story of J. A. Zehntbauer is only one of thousands in the Alexander Hamilton Institute's files. As you read it go back in your business memory five years.

How does your five years' progress compare with his?

Mr. Zehntbauer was a wholesale dry goods salesman and five years ago became President of the Jantzen Knitting Mills of Portland, Oregon, a $10,000 concern. It was at that time—when he was with a little company which might either remain little, or grow great, just in proportion to the business knowledge and judgment which he was able to bring to it—that Mr. Zehntbauer enrolled for the Modern Business Course and Service.

"I wish I could write a letter which would *fully* express my admiration for the Course," he says.

"In the years following my enrolment, our company has grown from a capital of $10,000 to $250,000. During the difficult period of 1921, our plant ran day and night for six months to keep up with orders. In addition I have fathered a movement which resulted in the organization of a $300,000 company to manufacture worsted yarns, and am treasurer of that company also."

How much is 50% of $240,000?

"It would not have been possible for me by experience alone to gain in a lifetime the knowledge that I have acquired thru the Modern Business Course," Mr. Zehntbauer continues . . . . . "I would feel that I was making a conservative statement if I should say that at least 50% of my success could be attributed to my contact with the Alexander Hamilton Institute."

The difference between a $10,000 company and a $250,000 company is $240,000 if one considers the capital stock alone. And fifty percent of this progress, Mr. Zehntbauer says, is attributable to the fact that systematic business training made it possible for him to do in five years what other men use up a business lifetime in achieving.

"Forging Ahead in Business"

If you will clip the coupon below we shall be glad to mail you the little book which formed Mr. Zehntbauer's introduction to the Alexander Hamilton Institute—"Forging Ahead in Business." Just what the Modern Business Course and Service is and does; just how it has helped men whose position and problem were precisely like yours—all this is explained fully in this useful little book. It will be sent without obligation.

The Institute seeks to persuade no man against his will. It asks merely for an opportunity to present the facts. Surely the rewards are large enough to justify you *now* in sending for the book and giving it an hour of careful thought in your own office or home.

Alexander Hamilton Institute
557 Astor Place, New York City

Send me "FORGING AHEAD IN BUSINESS" which I may keep without obligation.

Name .....
Print here

Business Address .....

.....

Business Position .....

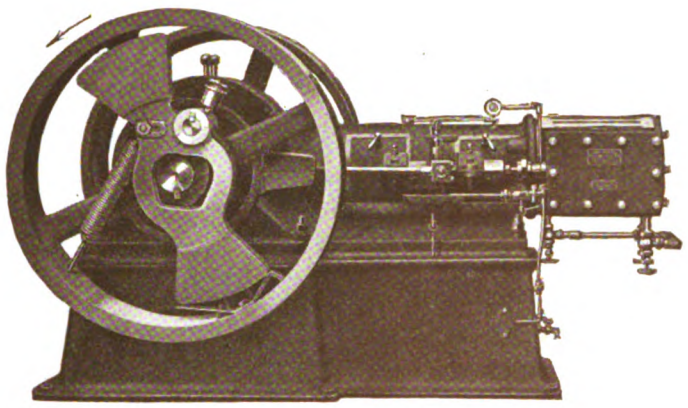
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ONLY STEAM ENGINES GOOD ENGINES ONLY



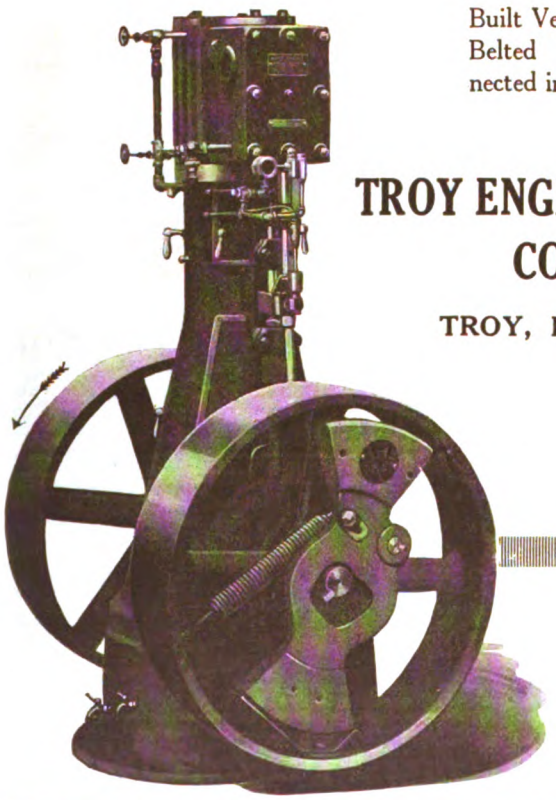
With the Automatic Oiling System

One of the reasons why Troy Engines deliver *greater brake horse power with the same steam consumption*, is the exclusive TROY System of Automatic Lubrication.

Bearings are automatically supplied with an abundance of oil. This flow of oil keeps all bearing clean and reduces wear to the minimum—thus, longer life to all parts subject to friction.

The circulation of oil starts with the starting of the engine and there are no oil cups to look after or fill frequently. The oil pump requires no priming—it starts simultaneously with the engine.

There are many other features which have been responsible for the increasing demand of TROY ENGINES as small size prime movers.



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TROY ENGINE & MACHINE COMPANY

TROY, PENNSYLVANIA

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Behind the Scenes at the Chicago Board of Trade

(*Continued from Page 9*)

ties do. At one side, on the floor of the Exchange, are arranged tables with samples of grain actually "on track" in Chicago, graded, and classified by official grain inspection. The grain which these samples represent is sold for cash and immediate delivery, not in the "pits," but by individual selection from the samples themselves.

The other class of transaction is dealing in grain for future delivery. All of the trade in future deliveries of contract grades of grain begins and ends right in the pit. And here is the most important statement of all:—every bushel of grain which is bought or sold on the Board of Trade is actually delivered when the contract matures. Behind every sale there is somewhere a warehouse receipt which will fill it. That warehouse receipt, tendered by the buyer to a public elevator which on the face of the receipt is declared to contain the grain, will procure for the holder the exact amount of the identical grade and description called for. Of course, this warehouse receipt may pass through a score of offices, before the final day of delivery, just as a $5 bill may settle a score of debts owing by one man to another in sequence. In the eyes of the law, this changing hands of warehouse receipts constitutes delivery just as much as does the execution of a deed for real estate.

Perhaps the thing that most impresses people who visit the Board of Trade is the sign language used in buying and selling grain for future delivery. Unlike everything else seen in any other line of business this wonderful system, while simple in its execution, nevertheless puzzles the uninitiated. It is a system that has grown up with the Board, and traders would be helpless without it. In that awful din where hundreds of men and boys are rushing about and shouting, individual voices are smothered and the trader must of necessity talk with his hands.

He has no time to waste—a lost second may mean hundreds of dollars to him. The rapid fluctuation of prices make quick action imperative, and this sign language has been developed to meet these demands. By a simple movement of his fingers the trader makes it known whether he would buy or sell, what price he is willing to pay or take, and what quantity he wishes to trade in. All the information necessary to consummate a deal, involving perhaps thousands of dollars, is conveyed by a few motions of the hand.

The sign manual of the pit trader is simplicity itself, consisting of only eight characters. The clenched fist represents the even price, say $1.25; one finger extended means one-eighth of a cent; two fingers spread apart, one-fourth of a cent, and so on up to five-eighths. When the four fingers and thumb are extended, but pressed close together, three-quarters is represented. The clenched hand with the thumb alone extended means seven-eighths of a cent.

These characters refer to the price, and the hands and fingers are held in a horizontal position. When the fingers are displayed vertically the quantity is indicated, each finger representing 5,000 bushels, up to 25,000 bushels for all four fingers and the thumb. When the desire is to sell, the palm of the hand is held outward and when the trader wishes to buy he does his signaling with the palm of his hand facing him. An offer of a trade is either accepted by a nod of the head or refused by a wave of the hand.

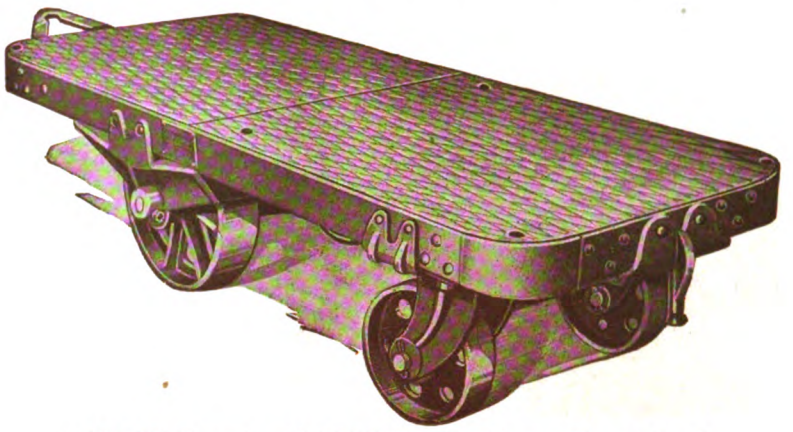
As fast as trades are made they are recorded on cards held by the two parties of the deal. These cards are printed in blue on one side and red on the other, the blue side being used for the recording of purchases and the red for sales. On the cards are put down the amount of grain traded in, the name of the party dealt with, and the prices at which the transaction was made. Thus, if Smith buys 50,000 bushels of corn from Jones at $1.25, his card reads on the blue side, "50—Jones—1.25," while Jones enters on the red side of his card "50—Smith—1.25." This con-

(*Continued on Page 28*)

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Are Your Haulage Conditions "Different"?

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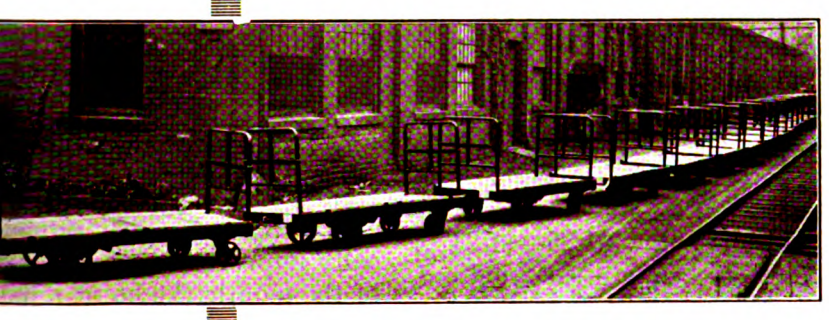
"K&J" Standard 6000 lb. Trailer—Furnished with either steel or wood deck.



The "K&J" Organization has designed and built trailer and trucking equipment for many, many plants over a long period of years. The Organization is well used to meeting conditions that are "different" and to solving the problems they offer, in a highly economical way.

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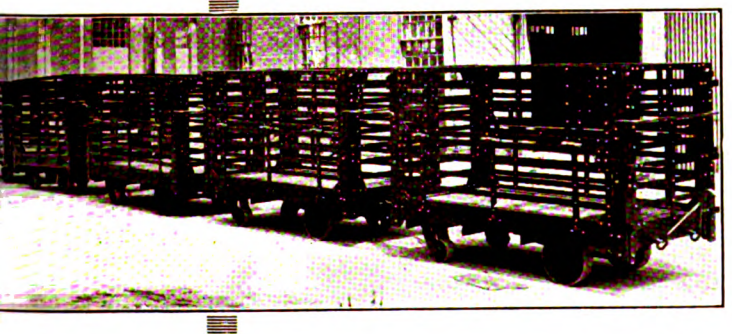
Where modifications, or entirely new designs, are clearly indicated, however, the "K&J" Organization will be the first to recognize the need and to provide designs or to build to designs submitted.



Notice carefully the rugged, simple design of "K&J" Trailers. Good trailers are really rail-less car equipment and, as such, are subject to conditions of stress, strain and impact peculiar to their class. That is why "K&J" Trailers are not built as modified hand trucks. You will be interested in the special, original features of design of "K&J" Trailer Equipment.

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The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio, U.S.A.

New York, 120 Broadway

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G-W Ground Storage Plant at H. L. Judd Co., Wallingford, Conn.

Assure Your Coal Supply

Strikes at the mines or on the railroads may any day reduce it to the danger point—may seriously interrupt your factory production.

Thousands of dollars in lost orders and expense incident to suspended operations are often the penalty for a depleted coal supply. Are you prepared to forestall this loss?

A Gifford-Wood Ground Storage Plant would provide you with an auxiliary, always-assured coal supply. Compared with over-head storage, its first cost is much lower and the simplicity of its construction keeps maintenance down to rock-bottom.

Would you like to talk to a Gifford-Wood representative? Or would you prefer a catalog first?

The Gifford-Wood Company specializes in elevating and conveying machinery for all lines of industry. These products include coal pockets, screens, elevators, conveyors, hoppers, locomotive coaling stations, elevating and conveying equipment for coal, ashes, stone, sand, gravel; wagon loaders, portable belt conveyors, pivoted bucket carriers, warehouse conveyors, car unloaders, friction clutches, hoists.

Main Office and Works: Hudson, N. Y.
New York Chicago Boston Buffalo

Gifford-Wood Co.

MATERIAL HANDLING EQUIPMENT

2081-R

(Continued from Page 26)

sumes but a fraction of a second of the trader's time, and thus he may make a dozen trades within the space of a few minutes.

One of the marvels of the commercial world is the system employed by the Board of Trade in sending out its quotations. Prices on the exchange are ever changing, and every change is immediately flashed broadcast over the country through the medium of the printing telegraph or ticker. The average number of quotations sent out in this way on every business day of the year is about 2,500 for all grain and provisions, the majority being on wheat. And the wonder of it all is that every one of these hundreds of quotations is available in every part of the United States and Canada, wherever a wire service is maintained, almost as soon as the price is registered in one of the pits of the Board of Trade. Yet familiar as is the sight of the ticker, with its continuous stream of figures on an unbroken line of narrow paper tape, and as simple as the process of ticking them off appears, it is really a complex and ingenious system with which few even in the grain trade are at all acquainted.

Minute after minute during the trading hours of each day prices of grain rise and fall. One instant wheat, for example, may sell at say $1.25 a bushel, the next at $1.25⅛, the next at $1.25¼, or possibly back to $1.25, or it may sell at fractions below $1.25—$1.24⅞, ¾, ⅝, and so on—the fractions always being one-eighth of a cent or a multiple of one-eighth. The total range of prices, from low to high, during a given day is determined by many factors.

Let us follow a single quotation emanating from the Board of Trade. To begin with, all commission houses doing business on the exchange have representatives or brokers in the various pits—one each for wheat, corn, oats, rye and barley, and provisions. Prior to the opening of a session, the brokers assemble in the pits awaiting the gong which announces the opening of the market. They may have any number of orders to buy and sell. During the trading hours many new orders may come in by telegraph or telephone. To meet the demand of the latter each commission house has one or more telephone operators on the trading floor of the exchange in close proximity to the pits.

We will suppose that a commission house with offices in a nearby building receives an order to buy 5,000 bushels of "May wheat" (by which is meant wheat for delivery during the month of May, even though the order is executed in March, or even an earlier month) at $1.25 per bushel. This order is immediately telephoned to the firm's telephone operator and the latter instantly rushes a written memorandum of the order to the firm's broker in the pit by messenger. If special haste is required he may flash the order to the broker by means of the trader's sign language.

The order to buy 5,000 bushels of May wheat at $1.25 having reached the broker, he proceeds to execute it by signaling his desires to some broker who is willing to sell at that price and who signifies his acceptance of the trade by a nod. The price at which the transaction was completed is noted by a trained observer, or pit reporter, on a raised platform at one edge of the pit, and here is where the transmission of the quotation over the wire starts.

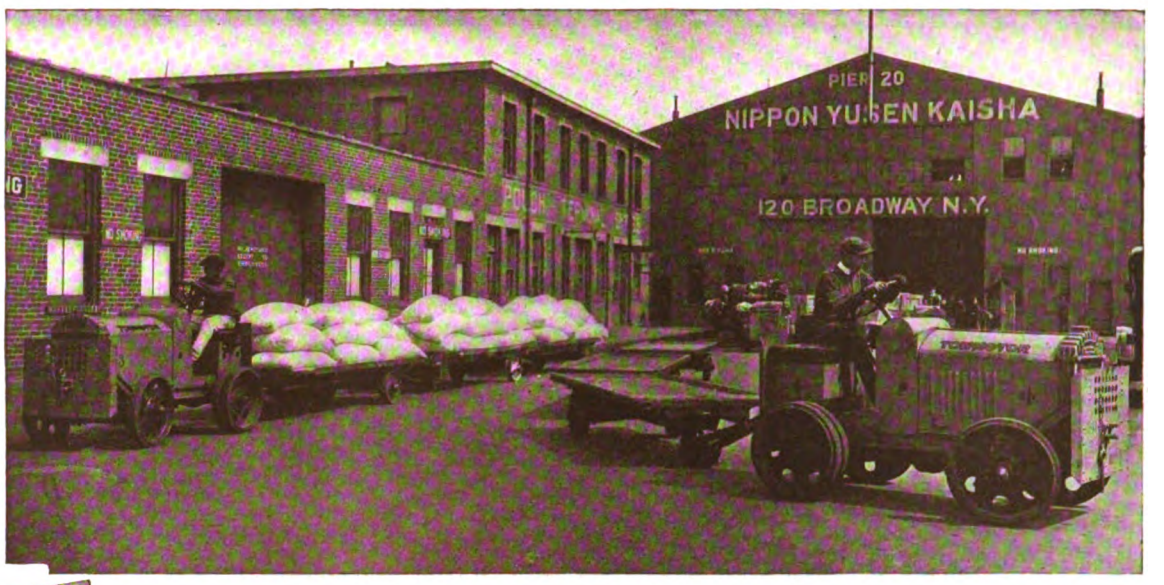
The pit reporter quickly writes the price on a slip of paper and flips it to a man at his side. The second man stamps the paper by means of a chronograph which automatically impresses upon it the day of the month, the hour, minute and second, and passes it to a third man on another platform just above and behind him. The latter, operating a "master-key," immediately transmits the quotation by Morse code to the office of the ticker company, where a telegrapher receives it through the medium of a telegraph sounder and re-transmits it directly on the key-board of the ticker, thereby reproducing the quotation instantly on any number of tickers throughout Chicago. Through the medium of a master circuit, connected with the "master-key" already referred to, which governs six automatic repeaters and to which are attached wires covering the en-

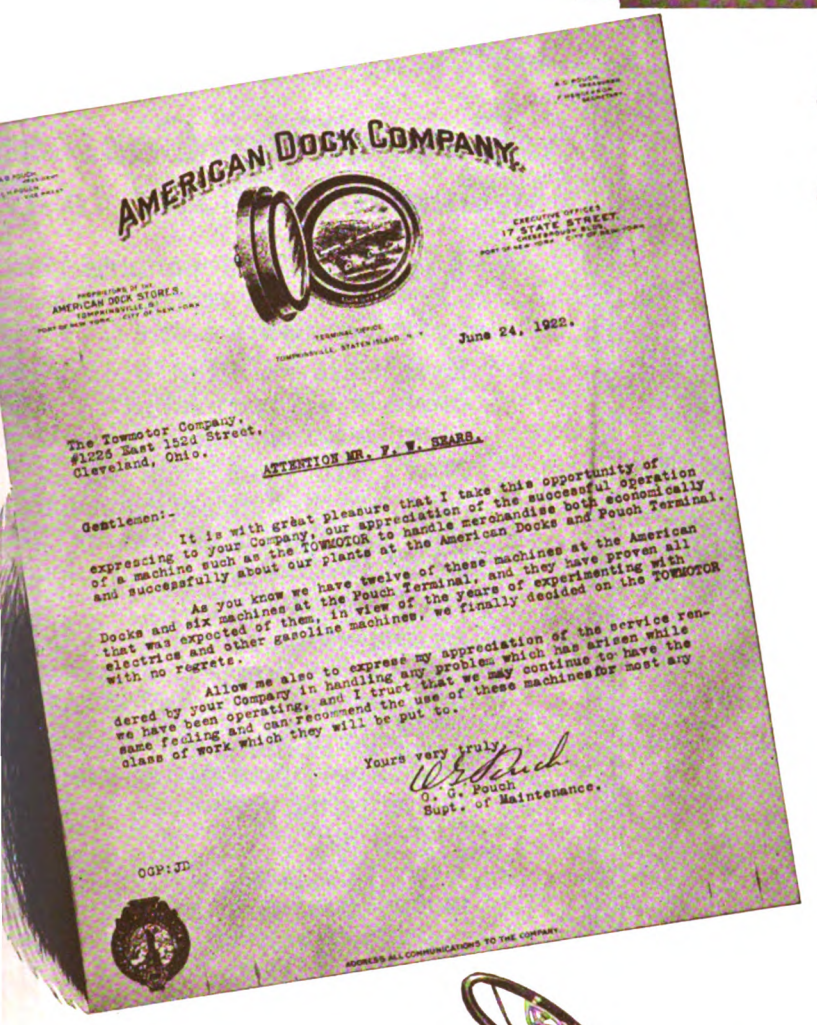
(Continued on Page 32)

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Picture shows one of the piers of the American Dock and Pouch Terminals at Staten Island, N. Y., where lower costs have been made possible by a fleet of TOWMOTORS.

The effect is shown by increased business, larger buildings, etc.




AMERICAN DOCK COMPANY

June 24, 1922.

The Towmotor Company,
1226 East 152d Street,
Cleveland, Ohio.

ATTENTION MR. F. W. SEARS.

Gentlemen:-

It is with great pleasure that I take this opportunity of expressing to your Company, our appreciation of the successful operation of a machine such as the TOWMOTOR to handle merchandise both economically and successfully about our plants at the American Docks and Pouch Terminal.

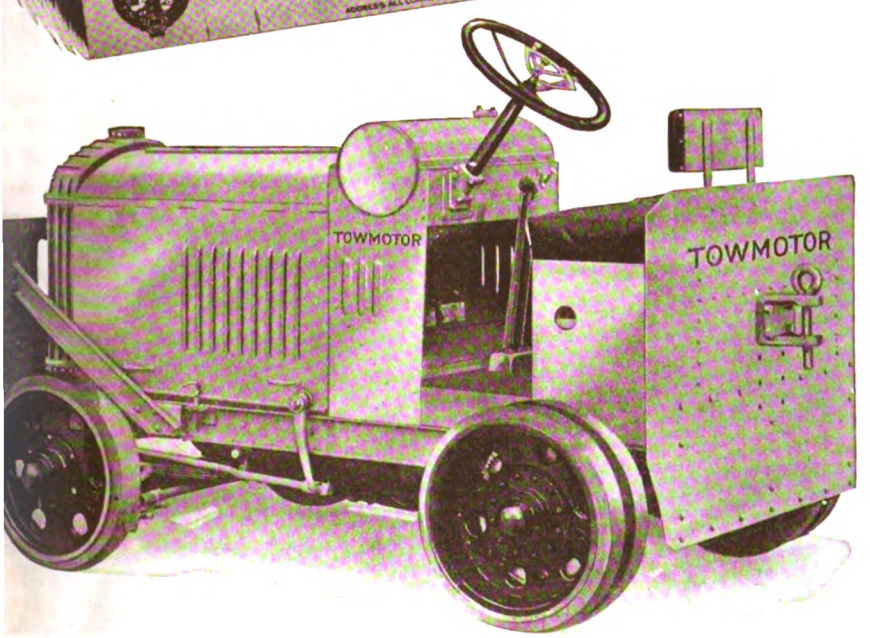
As you know we have twelve of these machines at the American Docks and six machines at the Pouch Terminal, and they have proven all that was expected of them, in view of the years of experimenting with electrics and other gasoline machines, we finally decided on the TOWMOTOR with no regrets.

Allow me also to express my appreciation of the service rendered by your Company in handling any problem which has arisen while we have been operating, and I trust that we may continue to have the same feeling and can recommend the use of these machines for most any class of work which they will be put to.

Yours very truly,
O. G. Pouch
Supt. of Maintenance.

OGP:JD

ADDRESS ALL COMMUNICATIONS TO THE COMPANY



Loading the Ships that Sail the "Seven Seas"

AT the American Dock and Pouch Terminals in New York Harbor, a fleet of eighteen TOWMOTORS are cutting labor costs and saving time in transporting freight between warehouse and ship hold.

The TOWMOTOR is always ready for duty. No load is too heavy to haul. A single TOWMOTOR will pull a train of trailers loaded with 30,000 lbs. of merchandise. And that is a common occurrence at these docks.

For Railway, Dock and Terminal Warehouse Haulage the TOWMOTOR is especially valuable. It will handle trailers singly and in trains—haul heavy machinery on skids—push or pull heavy packages and spot freight cars if necessary. Its flexibility is unsurpassed. It has sufficient capacity to move freight cars and still operate economically on light loads.

The TOWMOTOR is not a *remodelled automobile.* It is an *industrial tractor* driven by a gasoline engine *designed* and *built* especially for *industrial haulage.*

Ask any user how the TOWMOTOR will cut down your haulage costs and eliminate waste time and labor, or write to us for descriptive literature.

THE TOWMOTOR COMPANY

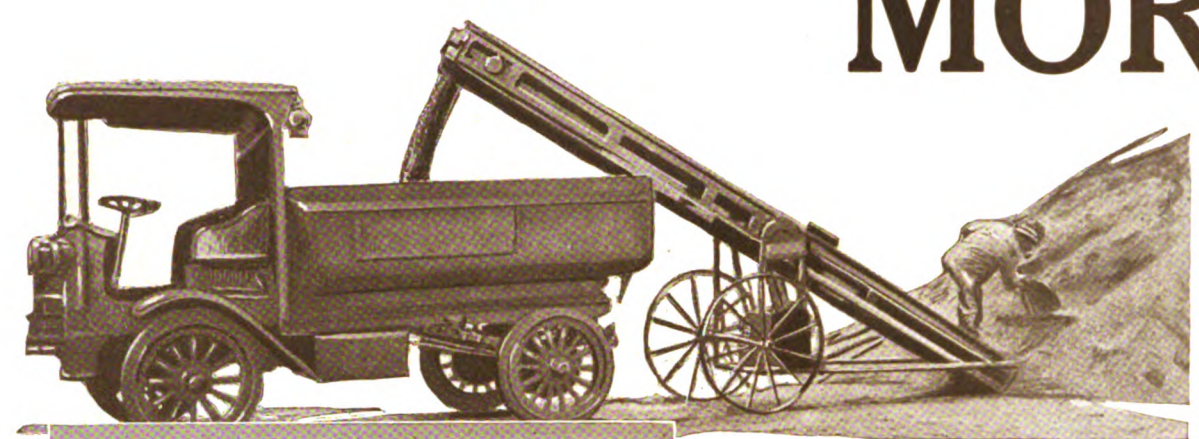
1226 East 152nd Street

CLEVELAND, OHIO

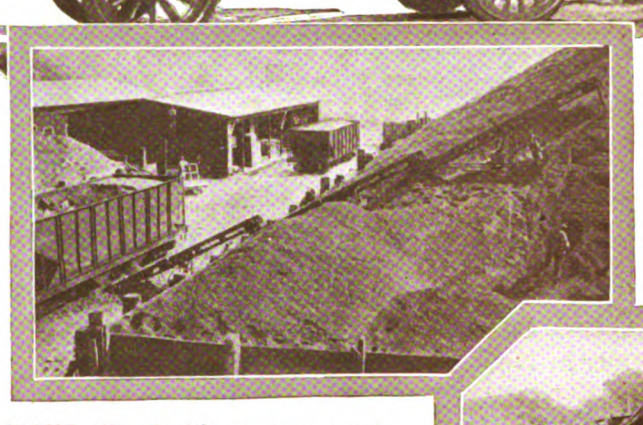
THE TOWMOTOR

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MORE TON



ABOVE—Loading coal into truck at the Campbell Morrell Co., Passaic, N. J. Note ease of feeding.



ABOVE—The flexibility and economical operation of these machines at the Gera Mills, Garfield, N. J., enable them to save a large amount of money in unloading their coal from cars to storage and then reclaiming to boiler room.

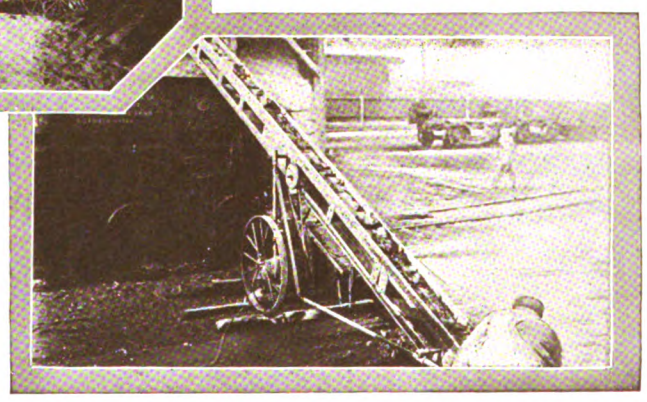


ABOVE—The Scoop Conveyor loading an electrical truck trailor for delivery to boiler room. This is an ideal installation where coat is received at a distance from the boiler room.



ABOVE—Two Scoop Conveyors in tandem tyle reclaiming coal direct from storage pile to boiler room at the Standard Oil Cloth Co., Athenia, N. J.

BELOW—Loading cars at the Carnegie Steel Co., Mingo Junction, Ohio.



Operating Cost of
Guaranteed Not to E

WAS ever a portable conve amazingly economical as thi Scoop Conveyor?

Ever since its debut 6 months a conveyor has been subject to an o in which Europe and America have

Now, with more than 500 of th Models in the hands of owners, the a favor and faith in the Scoop Conv repaid, we believe, by the reliabili ord it has established.

As owners of preceding models h testify, the Scoop Conveyor has been singularly economical to oper

But reports from owners show th models are operated for less than the operating cost of any previous Conveyor.

Even this pointed tribute to th model's economy is overshadowed positive expressions of praise from

Wr

THE CON

PORTABLE MA

PASSAIC

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ER DOLLAR

user

del Scoop Conveyor Cent Per Ton Handled

ıy of whom have handled large tonnage er all conditions.

ıumerous instances owners of the new lel report that their conveyors have re- ed no expenditure whatever except for er and lubrication.

y pay glowing compliments also to the eased power, the greater capacity and real portability of the new model Scoop veyor as well as to its dependability wide adaptability.

the one fact upon which all seize and ardently hasize and recur to again and again is the new p Conveyor's amazing economy which they t has never been equalled or approached be- even by the fine Scoop Conveyor forerunners. act, owners of the conveyors are unanimous roclaiming the 1922 Model the greatest Scoop veyor ever produced.

t bears them out in this verdict and estab- s completely the New Model's preeminence e fact that orders have come in so fast that ormer production schedules have been ex- ed.

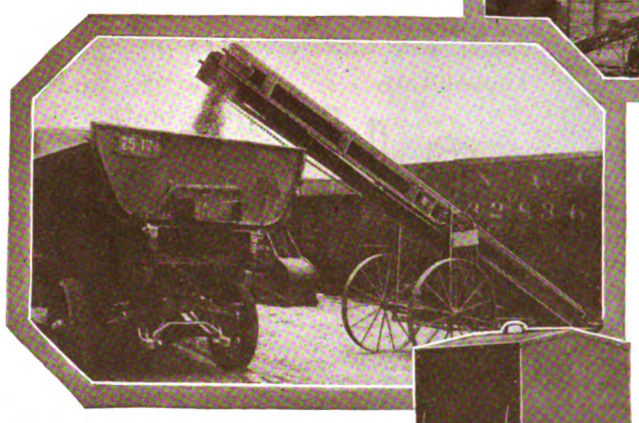
No. 63

OOP YOR



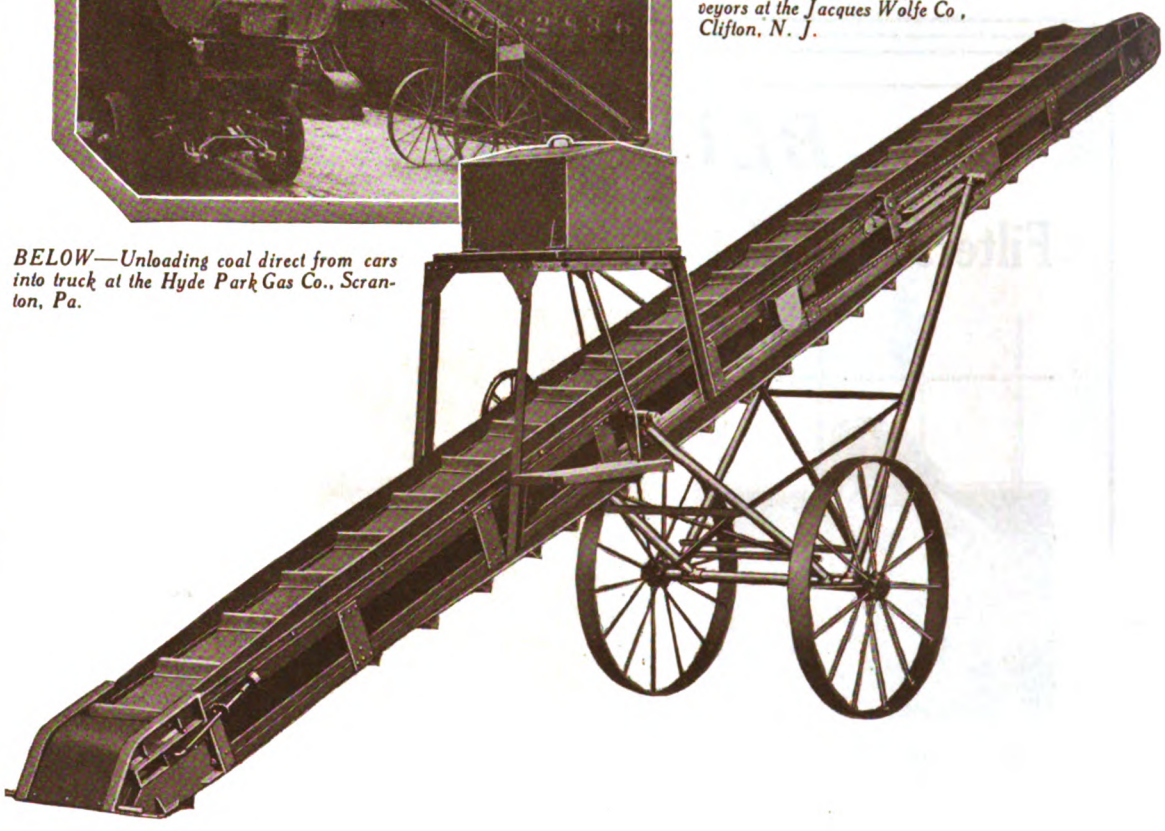
ABOVE—Unloading 50 ton cars in three hours at the Carey Salt Co., Hutchinson, Kansas.





ABOVE—Unloading and Storing Coal with two Scoop Conveyors at the Jacques Wolfe Co., Clifton, N. J.

BELOW—Unloading coal direct from cars into truck at the Hyde Park Gas Co., Scranton, Pa.



NERY COMPANY
EW JERSEY

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We Grow These Tanks!

To make sure of the quality of the cypress that goes into "The Tank with a Reputation" we use wood from our own trees, cut in our own sawmills, finished in our own shops by our own workmen with the benefit of thirty years experience in tank designing and building.

The combination means real economy to you in cost and in long, faithful service. Get the Caldwell story the next time you are thinking of tanks.

Send for Catalog

W. E. Caldwell Co.
Incorporated
2200 Brook St. Louisville, Ky.

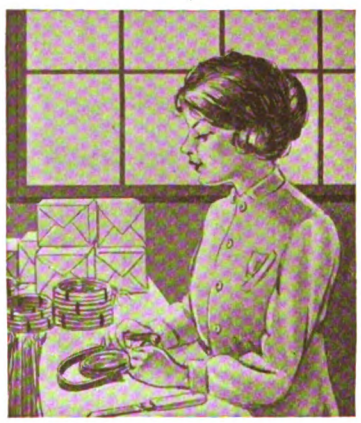
Caldwell TANKS AND TOWERS

BLU-EE

TRADE MARK

Filters out the Heat and Glare





BLU-EE (Blue-ease) is all that the name implies. Its blue color filters out the rays of the glaring sun allowing only those rays to penetrate that ease the workers' eyes. It cuts the glare and heat—it gives them a chance to do their best.

And it is easy to apply. Simply dissolve in hot water and paint on windows with an ordinary brush. One coat lasts for months. BLU-EE will not rub off. It will stand thorough dusting and even vigorous rubbing with a dry cloth. Easily removed with hot water.

Try some in your plant. You can do so at our risk. Sign the coupon below and mail it in at once.

PARK CHEMICAL COMPANY

3822 Edwards Road Cincinnati, Ohio

Try It Out—We Run the Risk

PLEASE send me 2 packages of Blu-EE, sufficient to cover 2000 square feet of glass. It is understood that I am to use one of the packages as directed and will remit $5.00 for both if I am satisfied with Blu-EE, and if not entirely satisfied may return the other within sixty days and you will cancel this order.

Firm Name..... Position.....

Your Name..... Address.....

(*Continued from Page 28*)

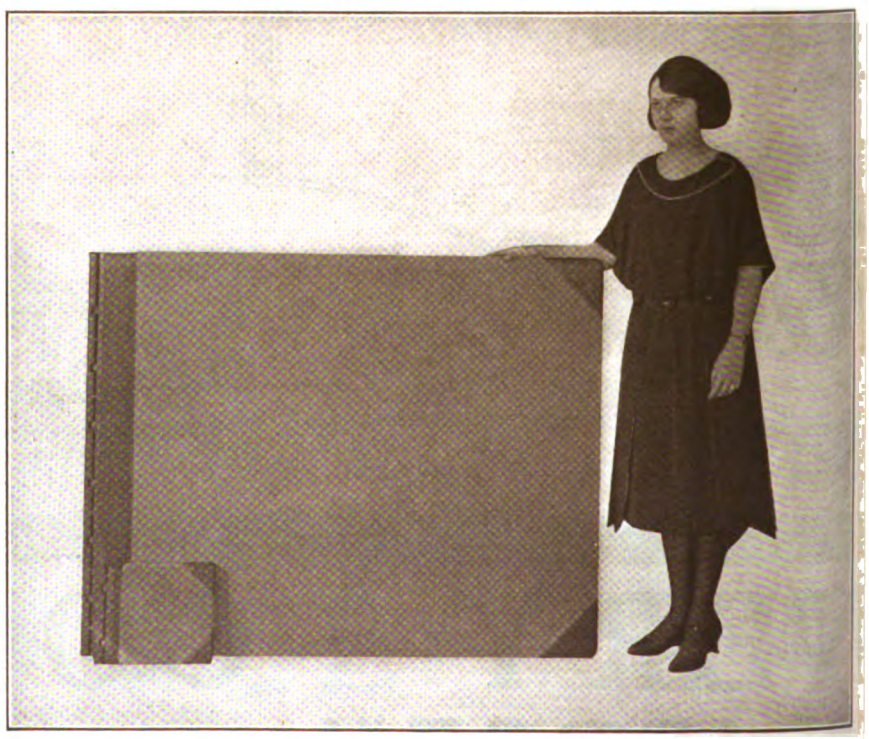
tire United States and Canada, the quotation is also received simultaneously by all points in these two countries which subscribe to the service.

While all this sounds more or less complicated, the system has been worked out to such perfection that the average time consumed in transmitting a quotation, from the moment a trade is made in the pit of the Board of Trade until the price at which it was made appears on the ticker, is only 3 3/5 seconds. The fastest time made is 1 2/5 seconds, and the greatest number of quotations ever transmitted in this manner was on August 14, 1914, when an average of 42 2/9 per minute was maintained for 102 consecutive minutes.

In addition to transmitting its quotations to every part of the country in the manner described, the Board of Trade also makes use of a special ticker service devoted to the dissemination of news, statistics, and other valuable information. This information is distributed over the so-called "Broad-tape ticker," an electrically operated instrument which is an important factor in the marketing of grain and provisions. The transmitter of this device consists of mechanism with a key-board like that of a type-writer and in operation works on the same principle as the key-board of the quotation ticker.

The tickers receiving this service, which are located in practically all commission houses and on the exchange floor, are connected by wire to the transmitter and print instantly, on a roll of tape about six inches wide, all news that is transmitted by the operator. Market news and quotations from all foreign countries as well as domestic markets are gathered and distributed over these tickers. The trader watches the news tickers very closely and is posted up to the minute on all important developments and general price exchanges in the markets of the world.

The elaborate collection of trade information furnished by the Board of Trade is given the widest possible circulation and is really for the benefit of the general public as much as for members of the exchange. Every effort is made to facilitate the prompt diffusion of the facts obtained, and this information, with absolutely no restrictions, is sent broadcast for the benefit of producer and consumer, buyer and seller, alike.

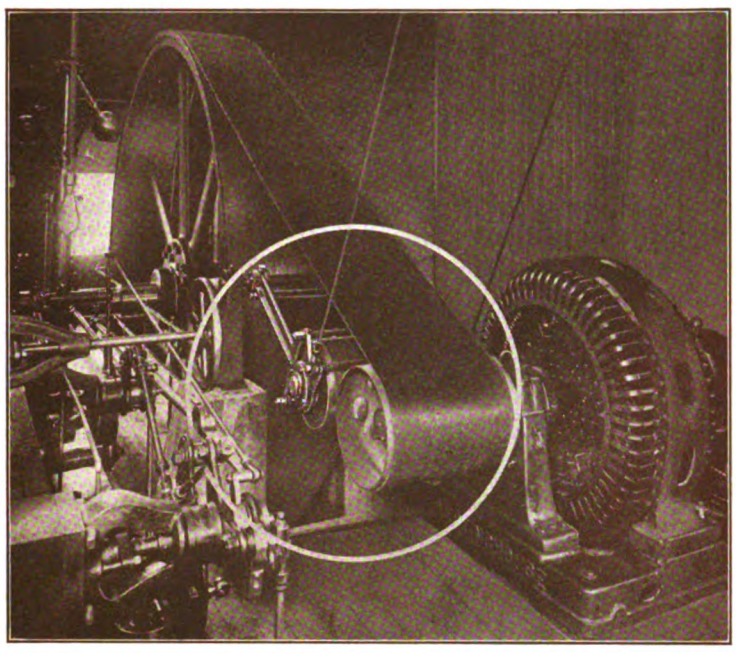


THIS IS THE LARGEST LOOSE LEAF BINDER EVER BUILT.

Made by the Kalamazoo Loose Leaf Binder Co., Kalamazoo, Michigan, for the John Hancock Insurance Company, Dallas, Texas. Weight—100 lbs., empty; with sheets—500 lbs. Size—41½ x 54 inches—9 feet wide when open. Holds eleven inches of sheets. The small binder shown is the usual commercial size.

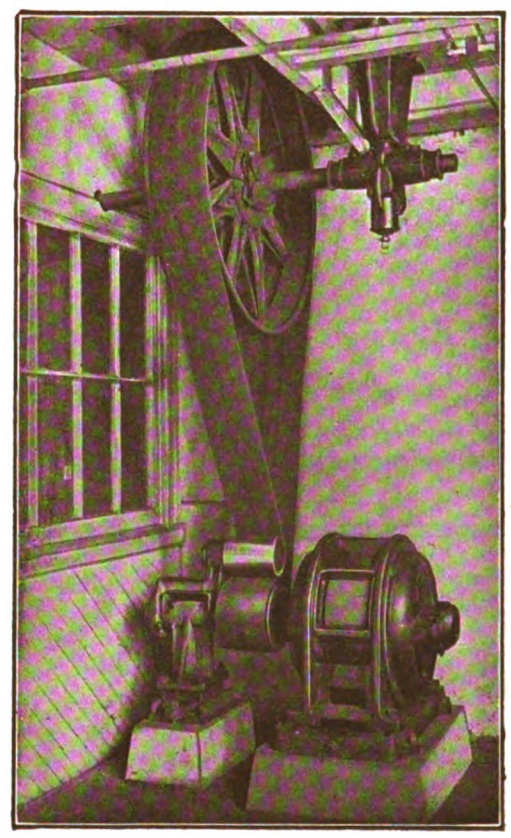
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The Korap*Lenix Drive

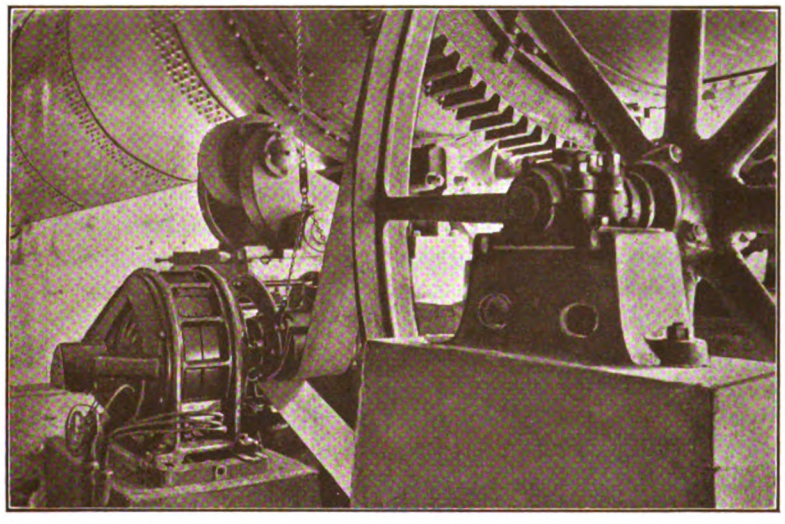


Corliss Engine Flywheel 18'0" Dia., 30½" Face, 61 R. P. M.
200 K W Generator Pulley 22½" Dia., 30" Face, 600 R.P.M.
Pulley Centers 16' 0"
Pulley Ratio about 1:10
Medium thick, double leather belt 28" wide

Not unusual applications, merely typical of the many thousands of KORAP-LENIXES installed on drives ranging from 3 HP to 1400 HP.



30 HP Motor Driven Lineshaft
Lineshaft Pulley 44" Dia., 9" Face, 156 R.P.M.
Motor Pulley 9" Dia., 9" Face, 720 R.P.M.
Double Leather Belt 8" Wide, 9/32" Thick



Motor Driven Rotary Kiln in Cement Plant
Kiln Pulley 10'0" Dia., 10" Face
Motor Pulley 12" Dia., 12" Face
Pulley Centers 8'0"
Pulley Ratio 1:10
Double leather belt 10" wide, 9/32" thick

Booklet
"SAVING SLIPPAGE AND SPACE"
describes other interesting KORAP-LENIX installations. Write for a copy.

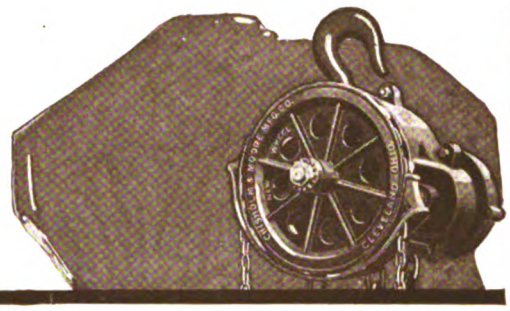
F. L. Smidth & Co.

ENGINEERS

50 Church Street **New York, N. Y.**

*Improved LENIX Drive

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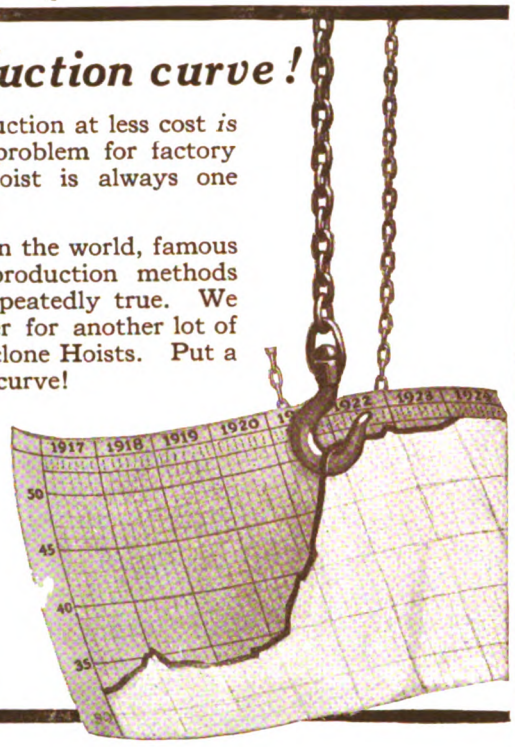


CYCLONE HOISTS
HIGH SPEED

—lift your production curve!

FASTER, smoother production at less cost *is and always will be* a problem for factory management. A Cyclone Hoist is always one sure means toward that end!

One of the largest factories in the world, famous for the wonderful, efficient production methods developed, has found this repeatedly true. We have just received their order for another lot of more than two hundred Cyclone Hoists. Put a Cyclone on *your* production curve!



Catalog sent on request. We have capable distributors in all localities to aid you in layout of material-handling and hoisting systems and submit estimates. Write.

The Chisholm-Moore Mfg. Co.
CLEVELAND, O.
Hoists : Cranes : Trolleys
Branches:
New York—Chicago—Pittsburgh

MORRiS PUMPS

One of the 65 Thousand

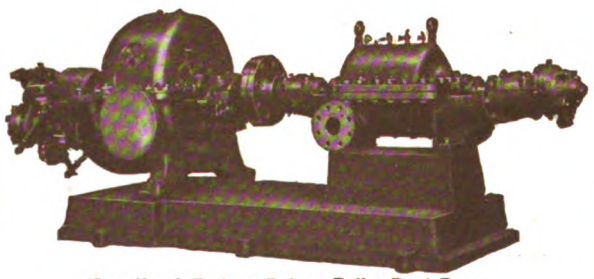
In the past 58 years we have built over 65 thousand Centrifugal Pumps of all types and sizes.

The Centrifugal Turbine Driven Boiler Feed Pump shown below, is characteristic of the type of Morris Pumps that are rendering efficient, reliable service, with the utmost economy in power plants everywhere.

The small space occupied, light weight and minimum attention required, make them far superior to reciprocating pumps for boiler feed service.

Learn details why Morris Pumps have kept the lead for 58 years, through our bulletins

Since 1864
Builders of Dredges, Centrifugal Pumps and Steam Engines



Centrifugal Turbine Driven Boiler Feed Pump

MORRIS MACHINE WORKS
200 Genesee St., Baldwinsville, NEW YORK

Pioneer Work in Developing the Radio Telephone

(Continued from Page 21)

went up a mile or more and talked to us making use of one of their latest compact sending sets installed on a training plane. A large stock of vacuum tube detectors, tuning coils and assembled sets were ready for use. This indicates that much had been done by the military people during the war to develop radio telephony but orders came soon after this to discontinue the work on account of lack of funds.

For some time after the war there was no organized effort to develop radio work. The amateur stations had been closed during the time we were at war and they gradually renewed their activity under strict regulation.

During the last two or three years, however, there have been installed at many places in our country high powered private sending stations that began to send out music, singing and reading of news items to all who cared to tune in to their wave length.

To-day the newspapers keep us informed of the latest developments in broadcasting and they print the programs which include everything from jazz tunes from a phonograph to the splendid voice of an opera singer and from a husky voiced advertiser of a new brand of soap to a lecture on psychology by a prominent college professor.

Our prediction many years ago that at some future time it would be possible for us to hear the news of the hour in spoken words at our breakfast table instead of reading it after it was several hours old in the morning paper is now practically being realized through the service rendered by the numerous broadcasting stations all over the United States.

It is probable that history will repeat itself in regard to the radio telephone. It will not supersede nor displace the older forms of wire transmission but will occupy a new field unique in many ways. A comparatively inexpensive receiving set enables anyone at no additional expense to remain comfortable at home and hear good music, speeches, sermons, lectures and a choice of other interesting programs sent out at prearranged times from convenient central locations.

All this seems to indicate that radio news and radio music and radio lectures will not displace our present arrangement in regard to these matters. The telephone did not displace the telegraph but supplemented it as a means of rapid communication over great distances. The telegraph systems continued to grow and increase in usefulness but the newer telephone soon reached a position of enormous importance in our social and economic life. Vast sums of money were expended in building equipment, lines, etc., and thousands of skilled mechanics and electrical experts have been constantly employed in the manufacture, installation, and operation of telephone apparatus.

Judging from the great demand for radio receiving sets today, a great manufacturing industry will spring up to supply this demand. Many experts will be required to install and operate the somewhat complicated apparatus at the highly powered broadcasting stations. There will be a new demand for power to operate these high powered stations requiring additions to generating and distributing and regulating systems of electrical energy and if the rapid rise of the telephone to a place of importance is an indication, we may expect that another decade will find a need for thousands of radio experts engaged in a new branch of electrical engineering, and if the advances made in the recent years are repeated in the years to come no one may safely say now what the future may bring. It is not beyond the range of possibility that a small pocket set will be developed that will enable the farmer to keep in touch with the good things of music and literature and art while he drives the cultivator over the field, the sailor can hear the sounds from the busy city while he speeds over the lonesome stretches of distant seas. The ambitious boy may get special lectures on subjects he is taking in school between his home study periods in the long even-

(Continued on Page 36)

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Mechanical Equipment Must Be Mechanically Right—

In a time recording machine, more than in almost any other piece of mechanical equipment, the machine must be accurate, durable and reliable—mechanically right.

During the past 28 years the Calculagraph has been working daily in thousands of machine shops, manufacturing plants, power houses, garages, billiard parlors, telephone switchboards, etc. It has been recommended and re-ordered by its users, because it has given REAL service. It is mechanically right.

There is no jumping and locking of the mechanism in the Calculagraph such as is found in electrically operated time clocks. The Calculagraph has a spring-driven, eight-day movement with jeweled balances. Its ribbon is easily inserted and automatically reverses itself. The cards for use in it can be of various sizes and shapes and can be furnished by your own printer.

The Calculagraph record cannot be faked. The imprints are made from metal type which rotate continuously. Setting the hands on the clock face will not in any way change the elapsed time record.

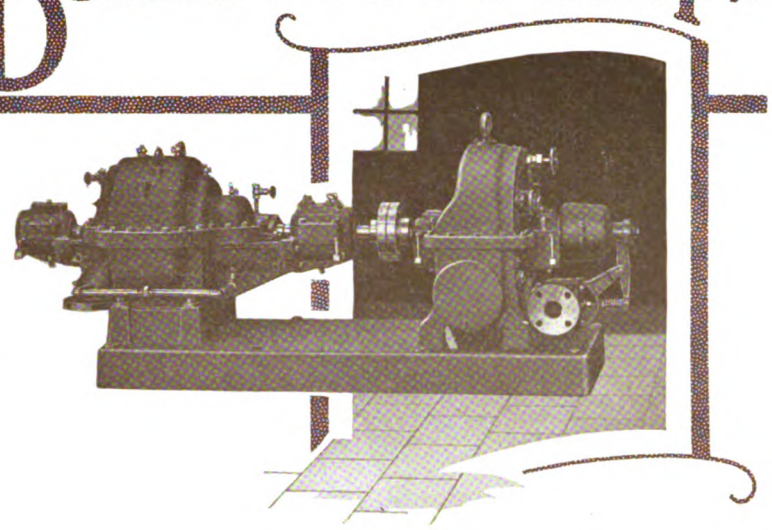
Let us send you a copy of —*"Elapsed Time Records"*— which tells the complete story of this durable time clock, so simple to install and operate.

THE
CALCULAGRAPH
THE ELAPSED TIME RECORDER

34 Church Street **New York City**

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Boiler Feed Pumps



IN plants of 1000 H. P. or over the centrifugal boiler feed unit has proved superior to any other type. It occupies less space, it requires but little attention its even flow of water prevents water-hammer with the attendant piping and valve repair costs. The Terry turbine for boiler feed service is easily adaptable to automatic control which will maintain either constant pressure in the boiler feed line or a definite excess pressure regardless of the quantity of feed water being pumped. The mechanism employed to accomplish this is mounted directly on the turbine and actuates the turbine governor valve. Of the 8,000 or more Terry turbines now installed, 2500 are used for driving boiler feed pumps. The features of construction that have made the Terry turbine so popular for this class of service are explained in Bulletin Z-25. Write for it.

T-774

THE TERRY TURBINE

Offices in Principal Cities in U.S.A. also in Important Industrial Foreign Countries

The Terry Steam Turbine Co. Terry Sq. Hartford, Conn. U.S.A.

(Continued from Page 34)

ings. The disciple of Isaak Walton may ease his conscience on warm sunny Sunday mornings while sitting on his favorite log beside his favorite pool by adjusting his head phones and tuning in to the wavelength adopted by his pastor while delivering his sermon.

Gasoline Rail Cars To Save Railroads Money

Latest Type is Shown at Railway Convention



Railroad officials, having become much interested of late in the gasoline propelled railway car, were given the opportunity a few days ago of inspecting the latest and most improved car of this type, when a White rail coach was run over the Pennsylvania railroad from Philadelphia to Washington, a distance of 136 miles. The car made the run to Washington for the annual meeting of the American Shortline Railroad Association and was the feature exhibit at the convention. It made daily runs during the convention over the tracks of the Washington & Old Dominion Railway, carrying as passengers representatives of the various short line railroads in attendance at the meeting.

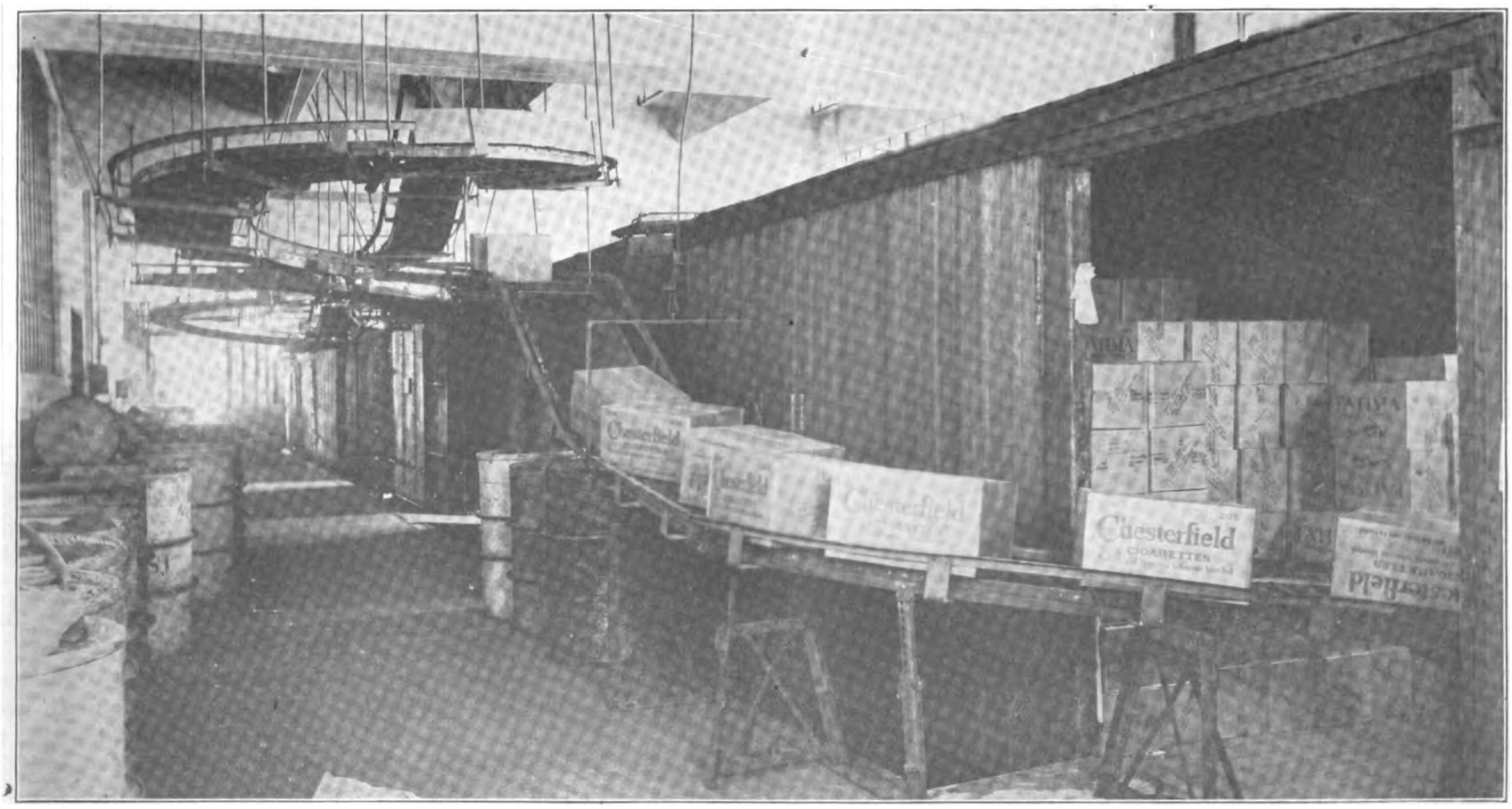
While a number of shortline railroads have been operating gasoline rail cars successfully for several years, it is only recently that the gasoline car has come to attract wide attention on the part of railroad men, not only operators of short line railways, but officials of some of the country's largest transportation systems.

Developments in the rail coach being watched with the keenest interest by railroads and the run from Philadelphia to Washington attracted numerous prominent Pennsylvania railway officials as passengers. Among the Pennsylvania executives who made the trip were: J. E. Burrell, superintendent passenger transportation, eastern region; F. K. Fildes, foreman mechanical engineers office, eastern region; J. M. Jones, passenger trainmaster, Philadelphia terminal division; H. K. LeSure, chief electrician, eastern region; H. H. Haupt, assistant engineer motive power, eastern region; J. Stair, Jr., general electrician,, New Jersey division; E. S. Stewart, advertising agent Pennsylvania system; James Buckelew, superintendent Maryland division; Timothy O'Toole, office general superintendent, southern division; Harry Babcock, passenger trainmaster Maryland division; Edward E. Hess, trainmaster Baltimore division and C. E. Wann, assistant trainmaster Baltimore division.

Other railway officials on the car were Senator George L. Shinn, president the Union

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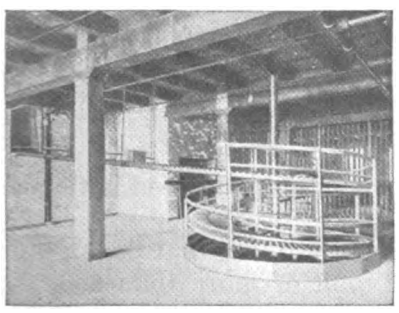
Handling Famous Cigarettes On a Famous Conveyor

IT'S A MATHEWS

Note how the Conveying System is arranged to deliver the fibre cases into any car spotted along shipping platform, by means of a portable unit shown in foreground. Trunk lines are suspended clear of the platform, leaving same free for foot and truck traffic.

We are solving Industrial Conveying problems every day. An engineer is ready at any moment to start work on yours. No cost, no obligation.

Ask for General Catalog.



MATHEWS
GRAVITY CARRIER CO.
157 Tenth St.

Branch Factories:
PORT HOPE, ONT.
LONDON, ENG.

ELLWOOD CITY, PENNA.



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"VERTICO-SLANT"

DRINKING FOUNTAINS



The Minimum Slant and Location of Nozzle Protects their Health

Every element of danger from contamination has been eliminated in the "VERTICO-SLANT" Drinking Fountains.

"Lips Cannot touch the Nozzle"

The nozzle, located in the recess prevents contact and the minimum slant of the stream incorporates the practical features of the vertical stream and the sanitary safeguards of the slanting ones. The water falls to one side of the nozzle instead of directly over it.

The "VERTICO-SLANT" Drinking Fountains are far superior to ordinary fountains and cost no more.

Write us to-day.

"Lips cannot touch the nozzle"

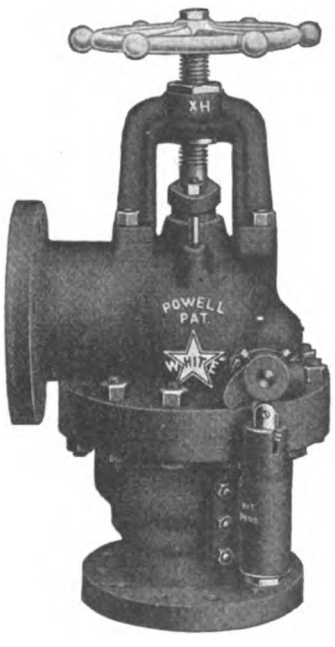
RUNDLE-SPENCE MFG. CO.

MILWAUKEE, WIS.

"WHITE STAR"

TRIPLE-ACTING *NON-RETURN*

REGULATING BOILER CHECK VALVE



Isolates the Boiler in Case of Accident

The Powell Triple-Acting Boiler Check Valve safeguards lives and protects property. If a boiler tube blows the valve closes, and the boiler is thus isolated from the rest.

All Powell Valves are thoroughly tested and guaranteed. Write for circular.

The Wm. POWELL CO.

2525 SPRING GROVE AVENUE

CINCINNATI, OHIO

POWELL VALVES

(Continued from Page 36)

Transportation Company, of New Egypt, N. J.; Fred Johnson, superintendent The Union Transportation Company and W. W. Wilson, general manager the Lewisburg, Milton & Watsontown Passenger Railway Company, of Milton, Pa. Representatives of The White Company, Cleveland, and the J. G. Brill Company, Philadelphia, made up the remainder of the passenger list.

The rail car driven to Washington was built for the Union Transportation Company and is now operating over the company's 25 miles of track, between Pemberton and Hightstown, N. J. The Union Transportation Company placed a 29-passenger rail car in service several months ago and its operation proved so successful that a second car of larger capacity was purchased.

The larger car—the one used on the demonstration run—has a seating capacity of 41 and a baggage compartment directly in the rear of the driver, who controls the car from the right-hand side. The body which is of semi-steel construction is mounted on a specially designed White Rail car chassis. There is a four-wheel pivotal truck in front and two wheels in rear. It is governed to a speed of 33 miles per hour. This speed was maintained with ease on the run to Washington. The satisfactory performance of the car both on the runs over the Pennsylvania and over the Washington & Old Dominion Railway from Washington to Great Falls, Va. much impressed the railroad men, who were given the opportunity of viewing its operation at close range.

The trips over the Great Falls division of the Washington & Old Dominion Railway were considered a severe test for the car as the road is a succession of grades and curves, the grades running as high as 3½ to 4 percent and the curves to 10 degrees, with a frequent combination of both grade and curve. The grades were negotiated with ease and a fair speed was maintained even on the most severe ascents. To demonstrate its reserve power the car on numerous occasions was brought to a stop when midway up a grade and again started. It accelerated readily and continued to top of grade without difficulty. This was true in both forward and reverse speeds. Refinements embodied in the latest type of rail car makes riding exceedingly comfortable. It has been the experience of The Union Transportation Company that passengers prefer riding in their gasoline rail car to their steam trains.

As previously stated, railroads are watching with keen interest developments in the gasoline rail car, recognizing that equipment of this type offers an opportunity of better serving the traveling public and at a cost far below steam train operation.

Railroad men are pretty well agreed that the expensive part of the railroad business is the running of thousands of miles of unprofitable passenger service on light branches of light portions of main lines where the people demand service. Once established, it is a difficult thing for the railroads to curtail such service even though it be unprofitable.

With recent improvements in the rail car before them, railway executives are alive to the situation and are now genuinely interested in the possibilities of the rail car as a solution to the problem of being forced to operate passenger trains where business does not justify doing so. They are convinced that the rail car, because of its light weight and low first cost, coupled with simplicity in operation and maintenance, is worthy of serious consideration.

Burning, Grinding and Sacking a Mountain

(Continued from Page 14)

in the kilns to cause the raw materials to fuse into "clinker." It costs around $1 a ton to pulverize this coal to make it possible to feed it through a blow-torch.

I am told that the significant item of more than $60,000,000

(Continued on Page 40)

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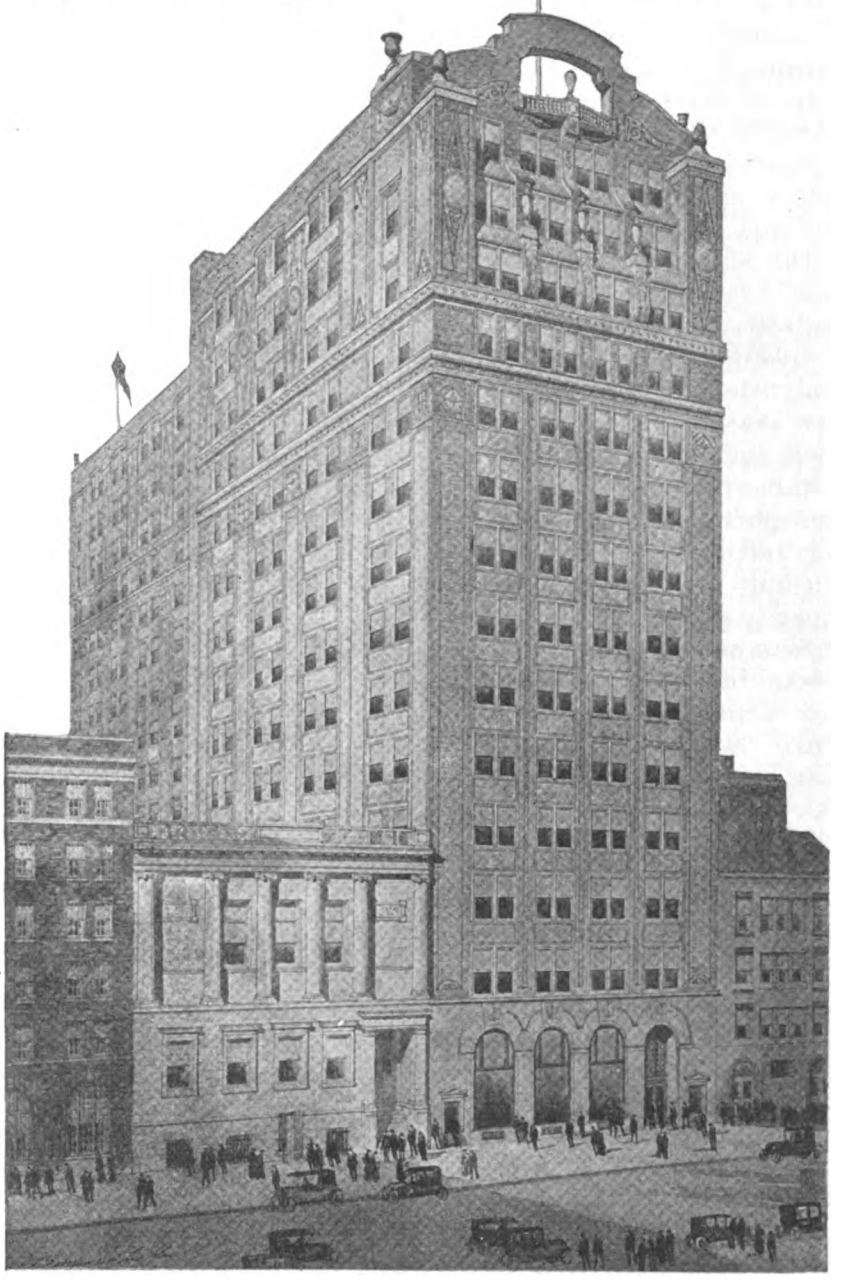
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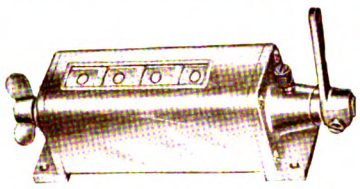
A Veeder Counter on his machine shows *him*—and the management—what his machine should turn out as a reasonable standard for the day's work.

If he does *less* than is fair the counter advertises the fact to all. If he does *more,* his claim to reward is equally plain. Thus do

Veeder
COUNTERS

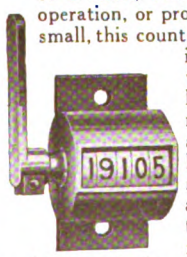
put the facts in the open, afford assurance of fair play and offer an obvious incentive.

The Set-Back Rotary Ratchet Counter below is for machines such as punch presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than* 1½ *size.*) Set-Back *Revolution* Counter of similar model, $10.00 (list.)

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines, and most adaptable for experimental work. If run backward, the counter subtracts. Price $2.00. (*Cut* 3/5 *size.*) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.



There's a Veeder exactly suitable for the type of machine you want one for; ask for free illustrated booklet.

The Veeder Mfg. Co.,
63 Sargeant St., Hartford, Conn.

(*Continued from Page 38*)

for labor was parcelled out among the hundred million barrels.

When you talk to a cement man his dry-as-dust subject is elevated from the commonplace and takes on a good deal of the romantic, which the outsider never sees in the other man's vocation. Just another way of saying that to each of us out particular calling is filled with romance. The great investment required before a cement plant becomes a going concern doesn't make cement manufacturing an inviting field of endeavor. Then too, cement marketing suffers the seasonal influence of the so-called construction season. A year's business must be concentrated into practically seven months. This reaches its peak often during the most active seasons for other industries, and as a result makes inevitable periodic congestion in transportation and distributing facilities. There is this constant handicap against capacity production. The fewer than one hundred producing plants in the United States, with a possible production of nearly 140,000 000 barrels per year, were never able until 1920 to exceed the hundred million barrel mark. In 1921, production fell back to 97,849,000 barrels due in part to the difficulties just related.

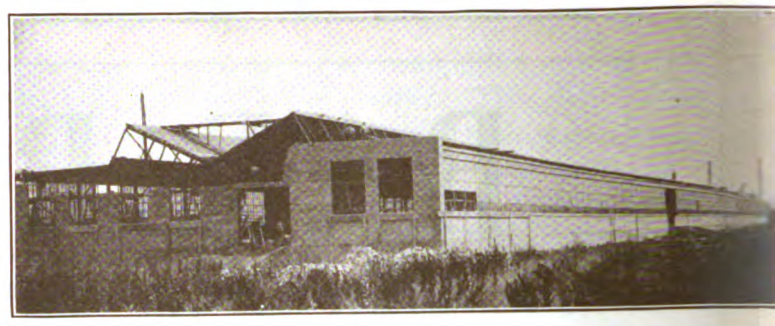
The iron age and the stone age are a matter of history. Occasionally we go back to "cave-man stuff." We are now entering the Cement Era.

It will surprise most people to know that exclusive of the functions of selling, accounting, and administration, the following operations are necessary to preparing a barrel of portland cement for the market:

LIMESTONE QUARRY
1. Drilling
2. Blasting
3. Pop shooting
4. Loading (steam shovel)
5. Transportation (locomotive and cars)
6. Track and Car maintenance

SHALE QUARRY
7. Drilling
8. Blasting
9. Loading (steam shovel)
10. Transportation (locomotive and cars)
11. Track and car maintenance

RAW DEPARTMENT
12. Primary crushing
13. Elevating
14. Secondary crusher
15. Elevating to storage bin
16. Storage (distribution in bin)
17. Proportioning of raw materials (mixing and conveying to dryer elevator)
18. Elevating to dryers.



Construction Costs
Have Reached the Bottom!

THE cost of building factory structures is at the lowest point since 1913. The increase in demand for additional manufacturing space which is already following the resumption of activities in many lines will soon produce an increase in building costs. Those who need factory space but have waited for the lowest point in building costs can profit by building during 1922.

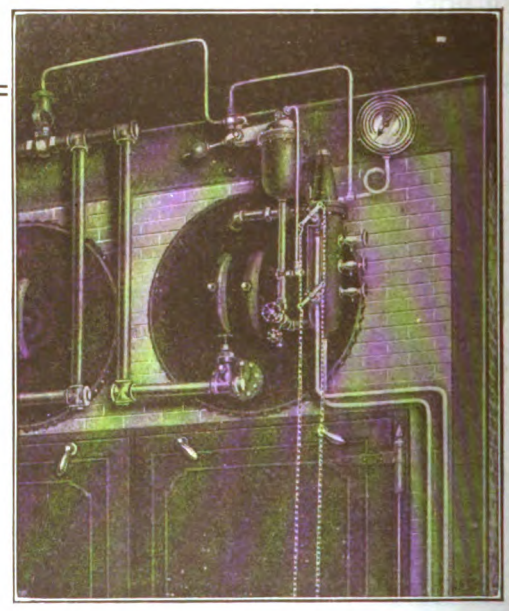
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VIGILANT
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Saves 6 to 15% Fuel Bills

The VIGILANT Feed Water Regulator keeps the water level at a fixed point irrespective of fluctuations in the load. It does it automatically. ¶ There are no complicated parts to get out of order—it depends for its operation on gravity. The action is therefore positive and always reliable. ¶ For over 20 years some of the largest plants have depended on the Vigilant for feed water regulation, and in many cases it effects fuel savings of from 6 to 15%. ¶ Write and get particulars and the reason why.

The Chaplin Fulton Mfg., Company
28-36 Penn Ave. Pittsburgh, Pa.

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19. Drying
20. Elevation to bin over preliminary grinders
21. Preliminary grinding
22. Conveying to elevators
23. Elevating to raw finish mills
24. Grinding by raw finish mills
25. Conveying to elevators
26. Elevating to kiln bins

CLINKER DEPARTMENT

27. Burning in kilns
28. Elevating hot clinker to coolers
29. Coolers
30. Adding gypsum to clinker
31. Elevating to preliminary clinker grinders
32. Preliminary clinker grinding
33. Conveying to elevators
34. Elevating to clinker finish mills
35. Grinding in finish mills

CEMENT

36. Conveying to elevators
37. Elevating to belt conveyors
38. Belt conveyors to stockhouse
39. Conveyor (distribution in stockhouse)

SHIPPING DEPARTMENT

40. Conveyor in tunnel under stockhouse
41. Elevating to packing bins
42. Packing (filling bags)
43. Loading in cars
44. Cleaning sacks
45. Counting sacks
46. Repairing sacks
47. Tying sacks
48. Inspecting loaded cars
49. Track maintenance
50. Cleaning and repairing cars

GYPSUM

51. Unloading
52. Elevating
53. Conveying to grinders

COAL MILL

54. Unloading
55. Elevating to dryer bin
56. Drying
57. Elevating to grinder bin
58. Preliminary grinding or small crusher
59. Elevating to finish mill
60. Finish grinding
61. Elevating to conveyor
62. Conveyor to kiln bins
63. Firing of kilns and dryers

POWER DEPARTMENT

64. Unloading coal
65. Elevating to bins
66. Firing of boilers
67. Moving of ashes
68. Pumping water
69. Operation of power units
70. Yard gang
71. Machine shop
72. Repair gang

CHEMIST WORK

73. Sampling rock
74. Sampling clay
75. Sampling gypsum
76. Sampling coal
77. Analysis all four
78. Sampling clinker
79. Analysis cement
80. Testing and making briquettes
81. Testing each car before shipping

SUPERVISION

82. General supervision, including:
    Superintendent
    Assistant superintendent
    Chief engineer
    Chief chemist
    Safety committee

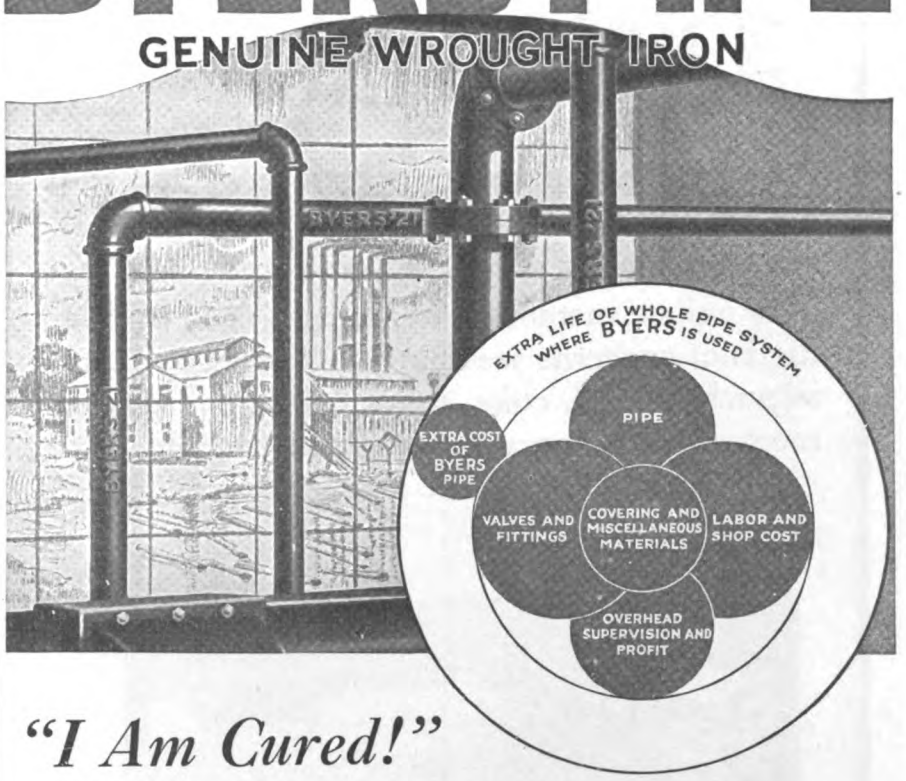


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Photograph by General Electric Co.

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Even leaving out of consideration this possible damage to the building and furnishings, the cost of pipe failures is ten or twenty times greater than the bare cost of the pipe itself. And the extra cost of Byers rust-resisting pipe measured against the installation cost, is only 5 to 10%. (See diagram). And this small amount is the means of greatly increasing the life of the installation, reducing maintenance cost, and preventing serious damage to the building and its contents.

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2 St. Mary's Boys Dormitory, Winona, Minn. Architect, C. H. Johnston, St. Paul, Minn. Byers Pipe forplumbing and heating systems.

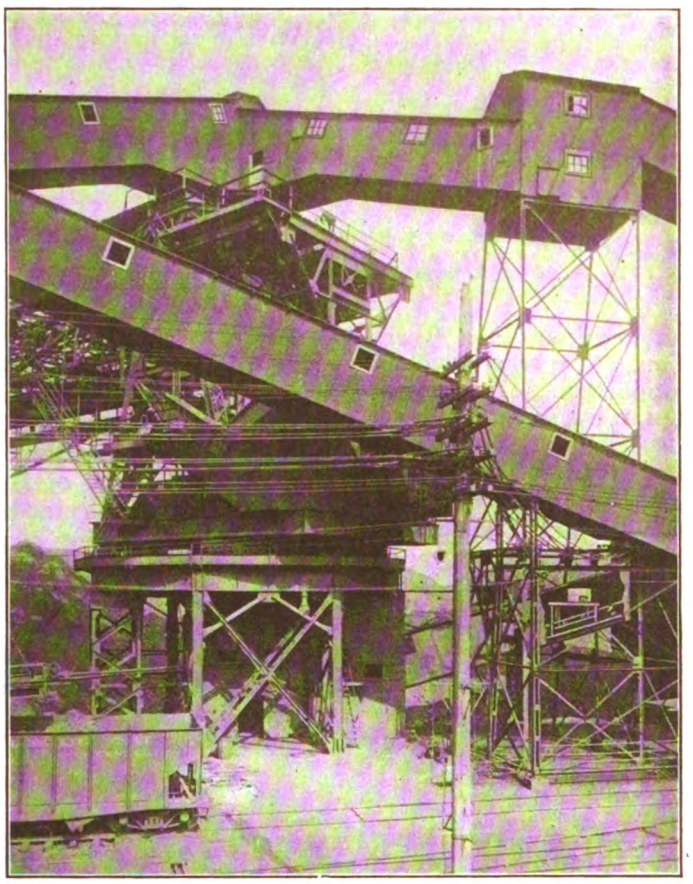
3 Stacy-Trent Hotel, Trenton, N. J. Architects, Esenwein & Johnson of Buffalo; associated with Architects William A. Klemann and J. Osborn Hunt, of Trenton. Byers Pipe for plumbing and he ting systems.

Look for the Name and Year rolled in every length

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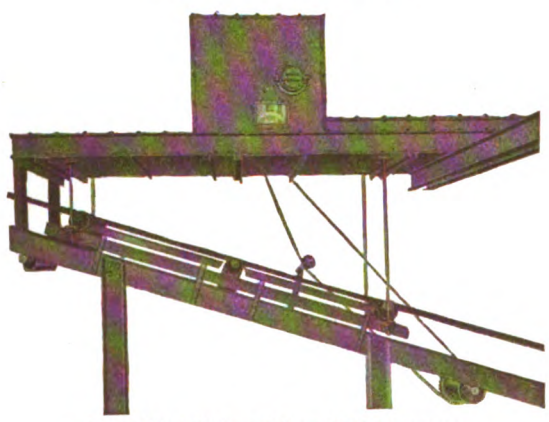
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Concrete, as Used in Ancient Rome

(*Continued from page 11*)

seemed to think it desirable to face their concrete is scarcely evident to modern eyes. The concrete when constructed of hard lava or travertine set into rock as lasting as marble, and the facing always came off before the concrete showed signs of destruction. Moreover the facing itself was often covered with stucco, as a basis for which the concrete could easily have been made better than the facing itself.

The Romans adopted concrete construction for many different purposes. It was of course of the greatest use for harbors as evinced by various remains of docks and wharfs. It was employed to line certain of the aqueducts, and the basins of the buildings from which the water was distributed, to say nothing of its use—in public and private baths. They even carried the cement to distant parts of the Empire, and made blocks with it for the facing of fortifications.

In making concrete floors, they appreciated the fact that great care had to be taken in order to avoid cracks. The general method of construction of such a concrete floor as described by Vetruvius may be quoted in part:

"I begin with the concrete floor which is the most essential of the concrete finishings, pointing out that great skill and the utmost care must be used to assure its durability. If this concrete flooring is to be laid even with the ground let the earth be tested to see whether it is solid there, and if it is, level it off and upon it lay broken stone for a foundation. But if the floor must be either wholly or partly filled in, this should be pounded down hard with great care. In case a wooden framework is beneath, however, we must see that no wall which does not reach up to the top of the house is built under the floor. No wall which is there should fall short so as to leave a wooden planking above it as an unsupported span. If a wall comes up solid, the unyielding nature of its solid structure must, when the joists begin to dry, or to sag and settle, lead to cracks in the floor on the right and left along the line of the wall."

What the Worker Wants

(*Continued from page 15*)

they wanted. Twenty-six lived near enough to eat at home, and the remainder would rather eat a lunch which they brought from home.

Replying to question 5—*Do you believe that employees should have a voice in making the rules they work under?*—the almost universal response was that they would like to have such a chance. Nine answered to the effect that they believed it the duty of the employer to make the rules and if the employee did not like it he could get out.

Question 6—*Are you fitting yourself for something better through a systematic study?*—surprised me. There were only four hundred and sixty-five making any form of a study to better themselves. The remainder claimed they were not overloaded with time for studying. This was due to long hours of work and much time to get back and forth to work.

Over seven hundred favored some form of a club in answer to question 7—*Do you favor clubs made up of employees?*—The remainder felt they would rather spend their time at home than at a company club.

In answer to question 8—*Are you married?*—I found seven hundred and sixty-two to be married. One hundred and sixteen lived away from home. The remainder lived at home.

Three hundred and ten lived in their own homes or were buying them. Five hundred were living in rented homes but wanted to buy.

Over nine hundred would rather own than rent. How-

(*Continued on Page 44*)

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USER REPORT SERIES

3

Written by users of B-G Machines
Audited by H. P. Gould Co.

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3. Loading of ashes by hand would require at least three times the labor now employed.
4. Original belt in use five years and still being used. No other repairs except on motor.

The machine is moved about the yard from one point to another where it is needed. It has proved itself adaptable and reliable. The following is part of the cost analysis furnished us by the H. P. Gould Co., industrial auditors, and Mr. A. MacLean, chief engineer of the Mechanical Rubber Co.

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Depreciation $\frac{\$900.00}{10 \text{ yrs.}}$	$ 90.00
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Maintenance and repair, estimated	50.00
Power—9 KWH. per day at $.01 per KWH. x 300 days	27.00
Total annual operating cost (excluding labor)	$196.70
Cost per day $\frac{\$196.70}{300 \text{ days}}$	$ .6556
Cost per ton $\frac{\$.6556}{46 \text{ tons}}$	.0142

INCLUDING LABOR

Cost of B-G Conveyor per day	$ .6556
Cost of labor per day, 3 men, 3 hours per day at $.60 per hour	5.40
	$6.0556
Cost per ton $\frac{\$6.556}{46 \text{ tons}}$	$ .1316

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CLEVELAND HAND OR ELECTRIC TRAMRAILS

(Continued from Page 42)

ever, many stated they had not bought because they were not intending to stay in the place they were. These, as a result of the question—*Which would you rather do: rent, live in furnished rooms, or board?*

Practically all said in answer to question 10—*Should a company help their employees build homes or pay them more wages that they might build themselves?*—that the companies could build cheaper than they could; yet, if the cost was the same, over six hundred would rather have more wages and build themselves.

Question 11—*Should the company educate their employees in their own plant or allow them to be educated in outside schools?*—Over eight hundred preferred to be educated in outside schools. These wanted such an education as would be of value when they should leave their firm. The remainder believed one would be as good as the other.

Those answering the question—*Should the company furnish a garage for employees to keep their automobiles in? If the employer expected you to keep a bicycle or automobile out in the rain and sun would it have any effect upon your working for him?*—indicated that there were about one hundred and sixty who rode bicycles and about sixty who went to and from work in automobiles. These believed that proper shelter should be furnished employees for automobiles and bicycles from wind and rain while they worked.

Question 13—*Would you join any cooperative associations made up of employees for the improvement of conditions either at home or in the plant?*—

Over eight hundred answers indicated that employees were interested in cooperative associations if composed entirely of employees. The remainder felt that there would be no value to be had from such associations.

About six hundred expressed in reply to question 14—*Do you believe rest rooms helpful?*—that rest rooms were helpful, while the remainder expressed a varied lot of ideas to the effect that they would not have time to make use of them.

In reply to question 15—*Would you do work you did not like, for more money rather than work you did like for less?*—there were over seven hundred and fifty who would rather do work they liked for less money while the remainder did not care as long as there was money in it.

The replies to question 16—*How many hours should a man work?*—were almost unanimous for the eight-hour day. Some said that the only reason they wanted to work longer hours was on account of the money. All felt that a man could do as much in eight as in ten hours.

In answer to—*Would you work nights for the same money as days?*—there were only fifteen who would rather work nights for the same money as they would get days.

In reply to number 18—*Which hours would you prefer: the eight hours beginning at seven in the morning, three in the afternoon or eleven at night?*—there were six hundred and thirty-four (five hundred and sixteen married) who preferred starting work at seven in the morning. Two hundred and eleven (one hundred and ninety-four single) who preferred to start at three in the afternoon and the remainder preferred to start at eleven at night (four of these were married).

Would you work at a factory that had poor street car service?—There was a general objection to working at a factory with poor street car service by those who were compelled to ride them. Over three hundred expressed themselves that they would not work unless there was ample service provided.

Should the foreman have the full right to discharge?—Over seven hundred and eighty believed that the foreman should not have the right to fire. This was because in such a case a man would be fired who might be first class but for a personal grievance.

Eight hundred and ninety-five, in answer to—*If you were capable of being foreman and a new foreman was brought in from the outside for your department would you quit?*—said they would quit, while the others ranged from "depending upon how well they liked the place," to the possibility of something better of a different sort later.

Would you study a corre-

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spondence course to improve your ability?—Over seven hundred and sixty said they would study a correspondence course while the remainder believed they could not derive a benefit from such a course.

* * * *

The questionnaire used in determining from the employer's point of view what he thought the employee wanted, brought out some peculiar information. On hundred executives were questioned in the same cities. Yet later in this article my comparisons will show what a vague idea employers have of the things employees really want.

Ninety answers to question 1 stated that they did not believe advancement counted in an employee choosing a place. The rest believed it did.

Almost unanimous response was obtained that executives believed employees objected to entrance training.

Fifteen believed that the employee preferred well-ventilated buildings; eighty-five believed that it did not make any difference.

Ninety-two believed that employees preferred to carry a lunch and sit down by a machine or bench and eat it. The remainder believed the restaurant was preferred.

Nearly eighty declared that their men would like a voice in making rules if they could get it. Ten believed they did not want a voice while the remainder could not answer definitely.

Ninety-six claimed that employees did not care to study nights to improve themselves. Four admitted good results from their employees studying nights.

Ninety-three claimed that employees did not care for clubs unless it would take them from their work with full pay. They insisted that attending clubs on their own time was not desired by their employees. The others had had pleasing results from clubs on employees' time.

I was surprised that eighty-nine should claim that the married man made the best workman. The other eleven could not determine much difference.

Ninety-six believed the employees wanted the employers to build their homes for them. Four believed the worker wanted to build his own. And

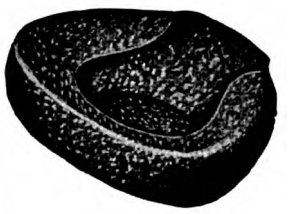
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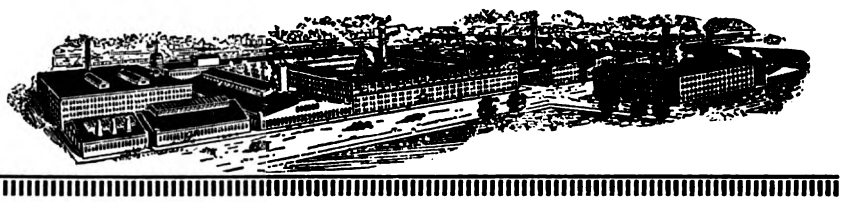
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Hays Draft Gage

Hays Draft Gages for the boiler front. They tell the firemen how to regulate his damper, the condition of fires, baffles, settings, etc. They are the compass by which the fireman steers the furnace. Black enamel finish, 1 inch range, $14.00.

The Hays Improved Gas Analyzer with its special metal needle valves instead of glass cocks or pinch clamp or rubber connections, its Hays patented steel wool method of absorption, its heavy moulded glass parts held by packing nut connections and its compact, rugged construction is the finest instrument of its kind on the market. CO_2 analysis in 30 seconds. Complete analysis for CO_2, O_2 and CO_2 in 4 minutes. Accurate to 1-10 of 1%. Three chamber analyzer $40, CO_2 only analyzer $30.



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The Hays Automatic CO_2 and Draft Recorder tells the complete story of furnace conditions. Firemen can head-off wasteful tendencies because they have up-to-the-minute facts before them. "What", "why" and "when" are pictured on the Hays Charts.

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Combustion Efficiency Appliances
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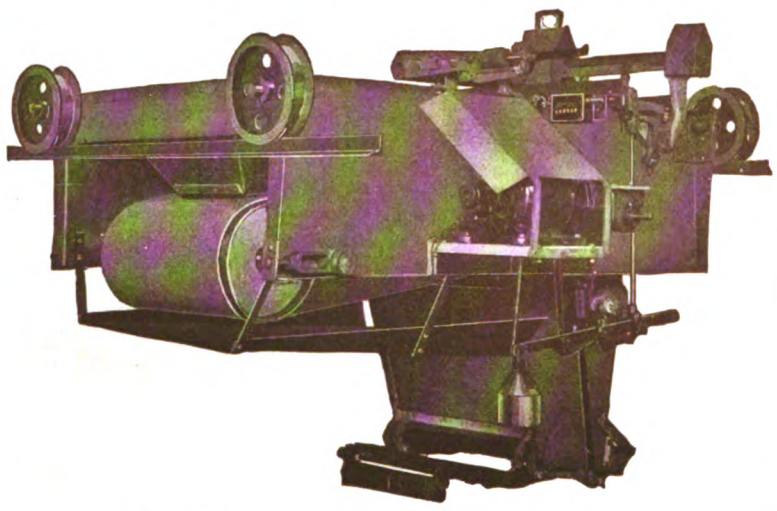
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Which of Your Boilers Burns the Most Coal?

Wasting Coal Is Wasting Power

Prevent It

By accurately checking the consumption of all of your boilers



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Automatic Coal Scales

Operate automatically and register accurately every pound of coal delivered to stokers per hour shift or day.

If a boiler isn't giving you the best efficiency, it will use more than the ordinary amount of coal. The trouble may be due to soot, scale, holes in fire, or to other causes that can be quickly detected if you know exactly how much coal the boiler is using.

A Richardson by weighing the coal automatically as it leaves the overhead bunker before delivery to stoker offers the practical solution of the problem of avoiding unnecessary waste of coal. The machine **will weigh any kind of coal,** wet, damp, muddy or frozen, easily and accurately. **Continuous records of consumption per boiler are always available for day and night shifts.**

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RICHARDSON SCALE COMPANY

Passaic, New Jersey

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only two believed home-owners were the best workers.

Ninety-two did not believe employees sought for an education either in the plant or outside. Six believed the employee would consider the real value of the education offered regardless of wherefrom. Two believed employees preferred company education because it was free.

Ninety-one claimed that they have never had a complaint as to garage facilities. Seven claim employees want a place to leave their bicycles and automobiles. Two could not answer.

Ninety-two asserted that employees use the rest rooms only during working hours; seven, that they are used during rest periods; one employer claims that they are not used at all.

Employers asked unanimously declared that money will attract men more than the kind of work.

Ninety-six claim men will work up to twelve hours for overtime and that they will loaf half of the time. Four believed the employees preferred a nine-hour day. (These four had a nine-hour day in force.)

As to night work, ninety-three could not decide whether men preferred days or nights; seven believed the men preferred days.

Ninety-seven could not answer whether poor street car service kept employees away from the plant or not. Three answered that many men quit because of poor street car service. (Two of these rode the cars.)

Eighty-six believed that employees preferred to have the foreman have the full right to discharge them. Ten believed they preferred to have some one higher up discharge them. Four were undecided.

Ninety-three did not believe their men cared how many men were brought in from the outside for good jobs. Seven believed that the older employees in point of service wanted the better jobs. Five never hired a man for the better job, but expected each man to work up.

Eighty-three did not believe employees were interested in correspondence courses. Eleven could not answer. The remaining six believed they did. (Four paid for courses employees would study and show progress in.)

As my questioning has been verbal, with the use of a notebook, I have chosen at random. I asked employees with whom I worked and employees I hired at the Studebaker Plant and at the Stenotype Company. Through the entire time I made special notes upon each one, as to his desirability, ambitions and education.

I find that, foremost in every employee's mind, he is looking for something better with responsibility; or he is shiftless and undesirable. The employee wants a place of neat appearance both interior and exterior. The corner of a factory grounds in western New York on the Erie Canal shown at the beginning of this article is the most beautiful spot I have ever seen on any factory property. Employees are always talking about such places and during the summer months it is surprising how many sit out there during their rest period.

The majority of workers, if paid as much for working eight hours as they would earn in ten will do more in eight and feel better.

Employees do care for the restaurant with its warm meal at noon.

I have noted in some factories where every man carried a lunch before a restaurant was opened, the first day the restaurant was opened only ten or twelve out of one hundred carried their lunch. However, I have seen company restaurants feeding very few. This was because portions were set out and a meal would cost sixty cents or more while the employees could go to an outside restaurant owned by private individuals and get a meal where everything was set before them in big dishes and help themselves to all they wanted for forty cents. Of course employees object to that sort of thing.

The most remarkable meal that I have ever seen is that put up by the Prest-O-Lite Company in their main factory. Here a meal is had for twenty-five cents—and all a man can eat. I can judge as I have eaten at over one hundred such restaurants and talked with those who have been eating in them.

Of course the worker is interested in the wage question.

(Continued on Page 48)

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—lower costs
—larger output
—reduced wastage
—smaller labor turnover
—more intelligent teamwork
—improved relations with the working force
—keener interest in managerial policies and plans

THE above are some of the results actually achieved by the 500 progressive companies which have installed a well-thought-out program of foremen training.

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During the past four years the Business Training Corporation has conducted *not less than 80 per cent* of all the training for foremen carried on in the United States. This record is in itself a sufficient guarantee that the training is sound and practical. It appeals strongly to the foremen themselves. The meetings are conducted by members of an experienced lecture staff. The expense is moderate.

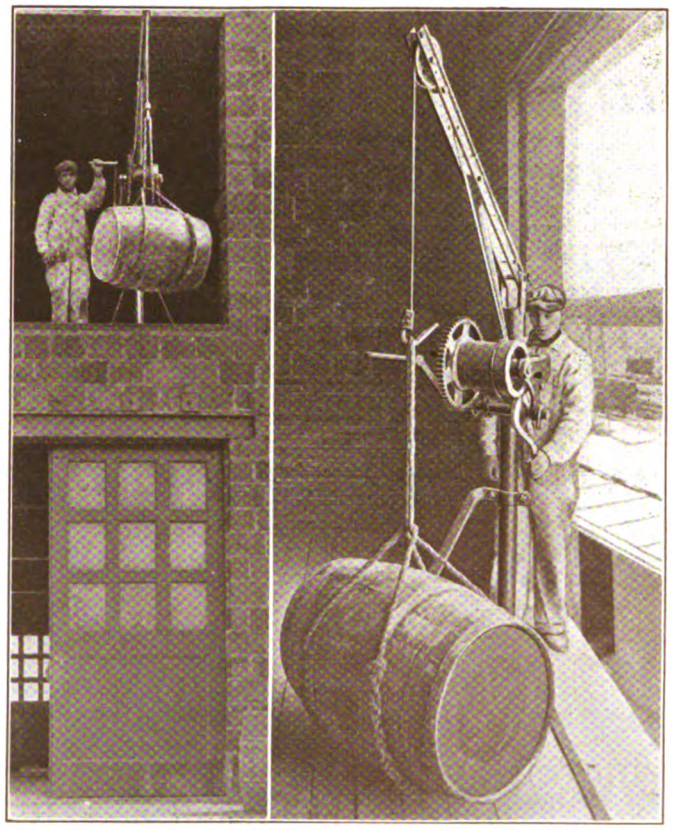
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G&G manually operated Hoist in use at the Riches-Piver Co., chemical plant at Lyons Farms, N. J.

From Loading Platform to Warehouse Floor—One man easily handles barrels, etc., with a G&G Hoist—

AT the Lyons Farms, N. J., plant of the Riches-Piver Chemical Co., 1 man with a G&G Model B Hoist raises barrels, drums, carboys and other loads quickly and inexpensively, and with a real saving in labor costs. With less efficient methods of load handling, from 4 to 6 men would be required to do an equal amount of work.

And the work is easy for the operator—a pressure of only 7 lbs. on the hoisting handle for each 100 lbs. of load.

If your plant handles loads up to 1000 lbs. between floors or from cellar to grade, there's a G&G Hoist which will fit your particular need. Five models, electrically or manually operated.

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REG. U.S. PAT. OFF.
Telescopic Hoist
with Automatic Gear Shifting Brake Device and Silencer

(Continued from Page 46)

Yet, after talking with many regarding this question, I find that the average executive knows little regarding the wages his men require. Almost unanimously the working man is asking for a living wage. It it no more than fair that his labor should net him a sum equal to his demands.

The shop view shown on a previous page is taken in the plant of the Lakewood Engineering Company of Cleveland, Ohio, and shows a modern way of trucking. Employees take pride in a firm which does its trucking in up-to-date ways. I have talked with truckers by this method who speak of their work with pride, while those pulling a hand truck barely will mention it.

After my quest of what the employee wants, let me say a word regarding the secret of it all. From all my questions asked the worker it will be easily seen that the installation of any factor I have mentioned will increase a man's pride in his work.

I have heard men working at the Prest-O-Lite Company when they were walking about in town, talking about the wonderful meal for twenty-five cents. In regard to a certain Motor Company, I have often heard: "I wish I could get in there as every man must work up if he wants a job there."

I have visited employment departments, apparently seeking a job yet actually seeking how they attempted to get men and what bait they used. After it all I find that if you give a man an opportunity to work and to be rewarded for good work, he will take more pride in the company. If you give him the responsible job with the raise, and show him that the firm really has an interest in him at heart, he will usually return that interest. Don't be afraid to call him "Jack" or "Bill," and if your name is Charles, you should be proud rather than offended to have your men call you "Charlie." It is that old time grip which the men miss, and anything which will bring it about is the thing men want.

New Fields of Usefulness for the Electric Furnace

(Continued from Page 20)

nace, the heating principle is very simple. As shown in the cross-section illustration, two rectangular carborundum channels, or trough are placed one on either side of the heating chamber of the furnace. In the melting furnaces, which are circular, this trough is exactly the same in principle, but becomes a ring in the upper part of the furnace. The trough is packed with granular carbon material, and electrodes are embedded in it to connect to outside terminals, so that merely by closing a switch any desired amount of energy may be passed into the carbon material, thus developing an incadescent heat. The heat in question radiates from the side and bottom of the trough directly to the material upon the hearth, and indirectly from the top of the trough to the roof of the furnace, and deflects upon the hearth. This results in the entire hearth area being subjected evenly to a large source of relatively low temperature heat. Any desired temperature may be obtained merely by moving the control switch to the proper voltage tap, and, after this action, no further regulation of the furnace is required.

The first illustration is a typical brass foundry unit. Such a furnace holds 800 to 1000 pounds of metal, and melts an entire charge every two hours. The usual foundry furnace is of 500, 800, 1500, or 2000 pounds capacity. Larger units than these are an exception in foundry practice, because the foundryman wisely prefers to have a battery of small units, rather than one of two large furnaces, which would tie up his entire production in case of shut-down for necessary repairs.

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There are more than one ndred installations of these sistance type furnaces in rious American non-ferrous undries.

The rolling mill furnace own in the second photo-aph is equipped for pouring, e metal directly into rolling ill moulds. This saves an in-rmediate pouring, does away th all crucibles, and greatly duces the labor required. A otor-driven casting table is ed with this furnace, so that ne man may tilt the furnace, rn the casting table to bring e proper mould into position r pouring, and in short per-rm the entire work inciden-l to melting and pouring the etal. Furnaces of this char-ter are in service in the nited States, Mexico, Eng-nd and Japan.

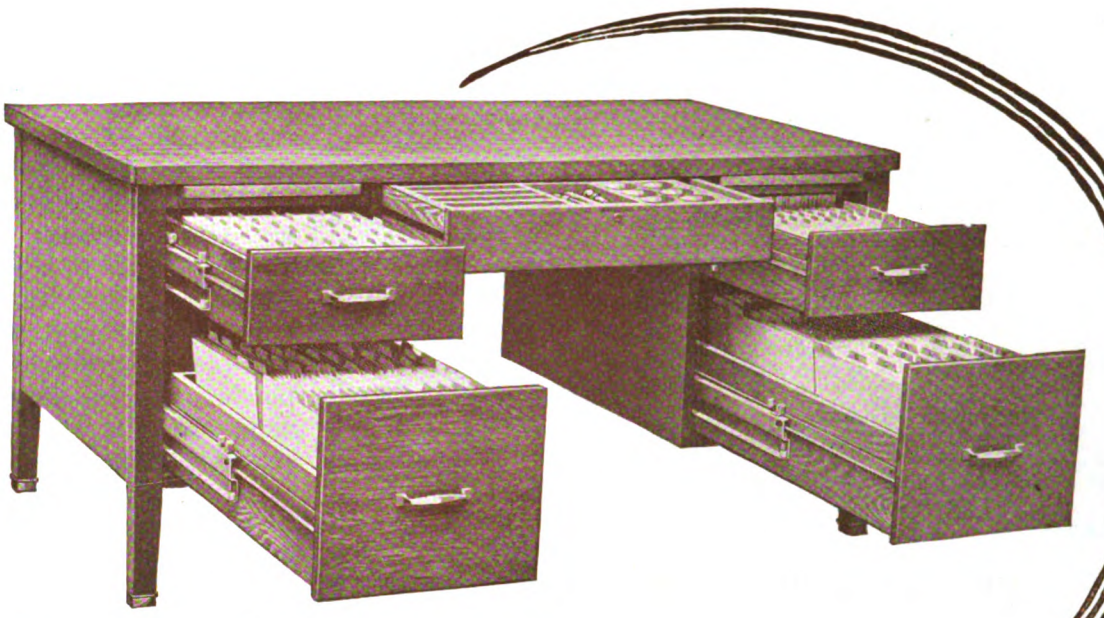
The third furnace is typical the electric heat treating nd annealing units which are ecoming so common in this ountry. Any temperature may e obtained by these furnaces ithin the limits of the furnace efractories. Completely au-omatic equipment is furnish-d, which carries the material rough the hardening fur-ace, quench and drawing namber, without any manual peration other than the peri-dic placing of the material be-ore the pusher of the first fur-ace. The control over fur-ace atmosphere, time and mperature, is absolute, and l rejections due to guess ork or mistakes in treatment re entirely eliminated. To umerate the list of products hich are being electrically eat treated would require a ecital of most of the kinds of eel castings and forgings hich must be subjected to eat treatment of any nature.

The fourth, fifth and sixth lustrations shows an electric rnace equipment which is a adical departure from other pes. This furnace is used r enamelling table tops, ove parts, refrigerator lin-gs, signs, and other porcelain atware, and is equally applic-ble to hollow ware, and any roduct requiring a surface of ultiple coats of baked enamel. he equipment in question is apable of handling a maxi-um of 2,430 square feet of at ware per hour.

A circular platform, some 00 feet in circumference, is oaded with the ware to be enamelled. The furnace travels around this platform, baking enamel as it passes. After the furnace has advanced, the finished products are removed from that section of the table, and new ware put in its place. This process continues for a full 24 hour period; workmen keeping continually ahead of the furnace, placing new ware on the table, and removing the finished material.

The furnace is in principle like a street car. An overhead trolley brings in the current to propel the car, and also the current for generating the heat to bake enamel. Any necessary temperature may be attained, perhaps as high as 1850° F. for the ground coat. The labor cost is cut in less than half. The supply of fuel is dependable at all times. There is a complete elimination of disagreeble factors as fuel storage and removal of ashes.

The furnace shown in the seventh, eighth and ninth figures is automatic equipment, designed for heat treating all



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THE "OVERHEAD FALLACY"

What is "overhead expense?" The dictionaries refuse to answer. Among manufacturers there are almost as many opinions as there are persons willing to express them.

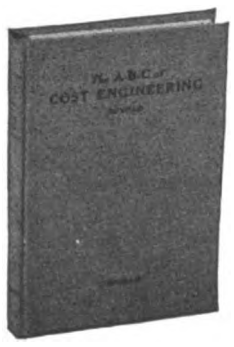
Large experience, careful observation, and consideration has convinced us that there is no "overhead" in manufacture. The term "overhead" is used by accountants, or others, to designate *en masse* the items of expense which they *no not know* how to measure into the product. *The use of the term "overhead" is an admission of ignorance.*

Dangerous Cost Systems

Any system in which an "overhead expense" group is created, and its distribution attempted, violates the fundamental principles of cost determination. Its results are unreliable because inaccurate to a dangerous degree. *Its user is fooling himself.*

The common practice of distributing either a "general factory overhead" or "departmental overhead" *on the basis of direct wages* is the greatest single cause of business failure among manufacturers. It invariably encourages the pushing of unprofitable business and discourages profitable business. *Stop fooling yourself.*

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Cost Engineering (Denham Methods) is based upon a full recognition and application of the fundamental principles of cost and expense distribution. It is the only method of cost determination offered to industries which will stand a thorough analysis and meet every test that can be applied.

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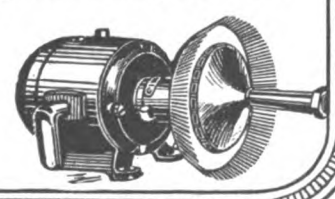
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sorts of automobile forgings. Since the parts treated range from crank shafts to the smallest parts entering into the construction of the car, the material is loaded into pans, which are placed on the charging platform by a motor-operated pusher. When the pan is driven into the furnace, all the pans within move on, so that the pan next the discharge door is pushed out into the quenching bath (as shown in Fig. 8). The time cycle is so arranged that the period of time necessary for the pan to pass from the charging door to the discharge end of the furnace is precisely the right time to give the material the designated heat treatment. After the material has been quenched for the proper time, an electric conveyor carries it from the quench onto the charging platform of the drawing furnace. Here the process is exactly the same as in the hardening chamber. This means that the equipment is practically "fool proof," and that the accurate heat treatment which heretofore was possible only on an experimental basis, is repeated as long as desired, no matter what the tonnage handled may be. After the desired treatment has been determined, the equipment must be set for the proper time and temperature in furnaces and the quench; after that it is necessary merely to feed the material. Since the treatment is an exact certainty and never depends upon the chance judgment of the furnace operator, all rejections due to faulty treatment are entirely eliminated. An automobile whose parts are heat treated in this fashion may practically guarantee its user against the annoyance of breakage of parts under strain.

The car type furnace illustrated in the tenth photograph is used for railroad frogs, crossings, and other castings which require for their construction the use of manganese steel. It has been the common practice with managanese steel to place the material upon the car, heat the same in the fuel fired furnace to a temperature of perhaps 1900° F., then remove the charge, and quench it immediately in water. This results in very serious breakage in the castings under this severe strain. The electric fur-



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ace eliminates this difficulty, ecause it supplies heat evenly o all the material upon the car, nd so prevents any part being eat treated too much or too ittle. After receiving this ort of treatment the casting is ractically certain to come hrough the quenching without reakage, no matter how much t may vary as to the cross sec- ion of its component parts.

A new and very rapidly de- eloping field for the electric urnace is illustrated in the leventh photograph. This is a nelting furnace utilized for precious metals, such as silver nd gold. The furnace is of the it type, and holds two No. 40 rucibles. The chief advantage f such a furnace rises from he fact that the precious metal s handled in such a manner hat the danger of loss is re- duced to a minimum. Mines, smelters, and refiners of Eng- and, Japan, United States, nd Mexico, have installed fur- naces of this character for sil- ver melting. The largest bul- ion manufacturer in England ses the nose tilting type fur- nace similar to the second il- ustration, but, of course, smaller in hearth capacity. In hese plants a close tab is kept on every ounce of the precious metal, and it has been found that the use of an electric fur- nace makes this task very much simpler. The Japanese mint uses the pit type electric furnace also for refining gold.

Another use for the electric furnace which is certain to prove popular is for the mel- ting of ferro manganese (see Fig. 12). It is common prac- tice in the steel foundry to have several heats coming off at the same time from open hearth electric furnaces. All of these require the molten fer- ro at substantially the same time, but ferro manganese be- ing volatile cannot be held in the ordinary furnace without serious loss. The resistance furnace with its sealed melting chamber, and its non-oxidizing atmosphere prevents this vola- tilization, so that the alloy may be held in the molten state for long periods without material loss.

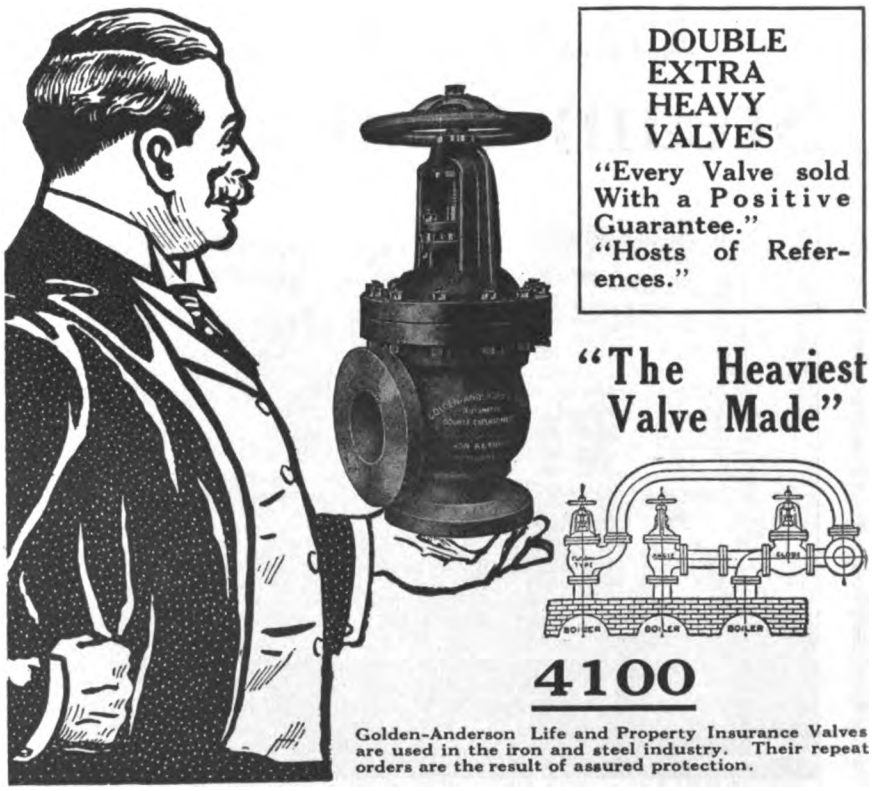
The furnace illustrated is rated at 360 K. W.'s in elec- trical capacity, and is capable of heating a ton of manganese steel every hour, and its car has an effective carrying ca- pacity of 12 tons of material.

In the mnufacture of auto- mobile body and fender stamp- ings it is of the highest impor- tance that the heating opera- tions be conducted with as lit- tle scaling as possible, for any pitting, due to this action, re- quires considerable additional labor in getting the defects sand blasted to sufficient ex- tent to get a good finish on the part. For this reason an elec- tric furnace, such as the fif- teenth illustration, was devel- oped. The most interesting feature of this equipment lies in the fact that it is portable and may be moved about from one part of the hammer shop to another. This was necessary because a large part of the pressing and drawing to shape is performed cold, and only one or two hot runs are required to perhaps six or seven cold oper- ations. The portable furnace is handled by a crane and taken from place to place, so that there are no idle furnaces while the material is receiving its cold runs.

The transformer and con- trol equipment is located on the roof of the furnace. Flexible leads are provided which mere- ly need to be plugged in to out- lets which are located in vari- ous parts of the building. The furnace is rated at 100 K. W.'s, and has a capacity for heating 750 pounds of material to 1800° F. per hour. By the use of this furnace scaling has been reduced to an almost neg- ligble item, and very much smoother sheets are obtained than were possible in the fuel fired practice.

The last illustration (Fig. 16) is a tilting type furnace employed in an aluminum foun- dry, making starting, lighting and ignition castings for auto- mobile work. This furnace has a hearth capacity of 500 pounds of aluminum and a melting rate of 350 pounds per hour.

While in aluminum melting there is not the problem of volatilization, which is so great a factor in melting alloys high in zinc, nevertheless there is the danger that the melt will absorb injurious gases, which pit the castings, and if not ser- ious enough to cause breakage, will at least result in very diffi- cult machining. The sealed chamber of the electric furnace keeps out all injurious gases of every nature, and produces a metal of the highest quality, at



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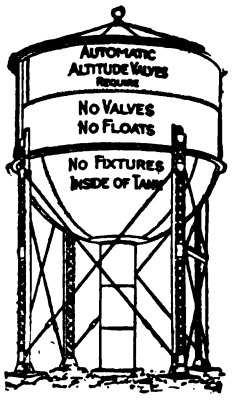
Automatic Cushioned Controlling Altitude Valves

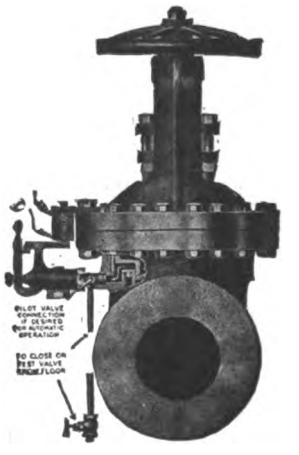


For automatically maintaining Uniform Stage of Water in Tank, Reservoir or Standpipes. Doing away with the annoyances of Freezing and Float Fixtures inside or outside of Tanks. Three Ways of Closing "These Valves."

1st—Automatically by Water.
2nd—By Electricity, if desired.
3rd—By Hand.

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so connected as to "work both ways" on a single line of pipe.





Golden-Anderson Pat. Cushioned Combined Throttle and Automatic Engine Stop Valves

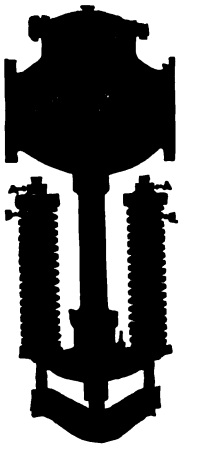
Give perfect automatic control of the steam or air flow in any pipe line from one or more distant points.
Can be opened or closed instantly in case of emergency by steam or electricity.
May be tested while in service, giving complete assurance of safety.
Positively cushioned by double Corliss Dash Pot. No banging, sticking or chattering.
Contain no springs or tight-fitting parts.
Can be adapted for automatic closure in case steam pipe bursts.
Double extra heavy and virtually indestructible.

Golden-Anderson

Pat Automatic Cushioned Steam Pressure Reducing Valves

Automatically hold the reduced steam pressure constant.

Fitted with patent safety piston that prevents high pressure escaping to low pressure side.

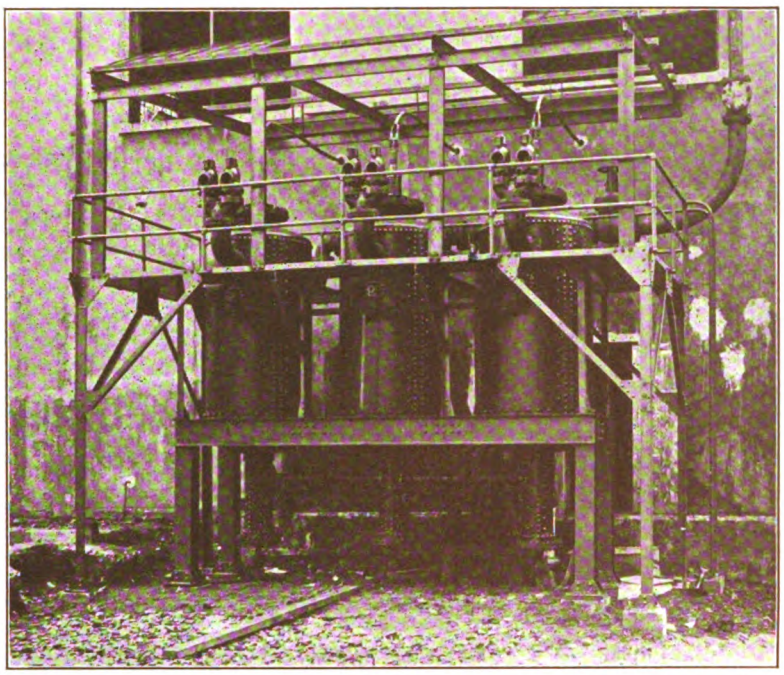


Golden-Anderson Valve Specialty Co.

1306 Fulton Building **Pittsburgh, Pa.**

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"ELECTRO" Steam Generator



18,000 KW "ELECTRO" 1,800 B. H. P. Steam Boiler, operating on 12,000 volts, 3 phase, 25 cycle, evaporating 54,000 lbs. of water per hour at 125 lbs. pressure. Owned by Niagara Falls Power Co., supplying steam to the Cliff Paper Co., Niagara Falls, N. Y.
Floor space and height required: 21′ x 10′3″ x 22′.

Generates Steam Without the Use of Coal or Other Fuels

THE "ELECTRO" Steam Generator makes it possible to utilize a portion of the electrical current available, where high voltage alternating current is used and which in many cases is wasted a part of the day.

The "ELECTRO" generates steam by the passage of high voltage alternating current between specially designed electrodes immersed in water. Saturated steam at any pressure, can thus be delivered in a remarkably short time and the apparatus uses only a fraction of the space required by a fuel burning boiler.

The amount of steam generated, the pressure and the amount of electrical power used is under absolute control and is governed by the height of the water in the tank or the depth of immersion of the electrode in the water.

The "ELECTRO" is fully approved and sanctioned by Boiler Insurance underwriters—the whole Generator is grounded and safety is assured for the operator.

Industries located within the range of Hydro-electric power plants will find the "ELECTRO" Steam Generator particularly adaptable, because economic use can be made of the surplus energy and water.

Thus steam is generated at practically no cost—simply the cost of maintenance—and former wastes are turned into useful profitable work.

Send for further particulars of this remarkable steam generator and a list of users.

ELECTRIC FURNACE CONSTUCTION COMPANY
908 Chestnut St. Philadelphia, Pa.

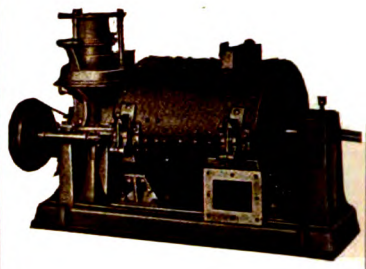
the same time greatly reducing the percentage of rejected castings, and, consequently adding to the productive capacity of the foundry.

These all are typical examples of what the electric furnace has already accomplished. What fields of usefulness it is about to enter, is a subject of universal interest. Electric melting furnaces will no doubt, some day, find wide application as large steel mixers for degrassifying molten open hearth or refined electric steel. In iron foundries, for use in connection with, or without, the use of a cupola, they may be utilized as holding furnaces, and also for melting cast iron borings. If power rates can be made sufficiently low, they may, some day, be applied to the smelting of copper and iron ores. In the glass industry electric heat will be utilized for closed pots, for single and multiple pot units holding colored glass, and also, it is predicted, that electric heated leers are bound to show a great advantage both in economy and quality of operation.

In the opposite field of heat treating and annealing, the electric furnace will probably find widest application for soaking hot ingots, re-heating billets and blooms when used in connection with fuel fired pre-heating furnaces, for annealing sheets and cold rolled stock, for the re-heating of steel bars, and the annealing of tin plate as well as for heating the tin pots. Another important development will be the electric heating of steel for drop forgings, as work at present performed with oil, at poor economy, in units which are excessively small in size.

Since the application of electricity to heating problems means the development of the maximum quality of each metal, American engineers will never be satisfied until the advantage of this ideal heating fuel are extended to every branch of industry, at a cost which will place the new fuel within the reach of all. This application, some day, will be available for every plant; whether it be the smallest foundry, which might require but a single unit; or the very largest plant, which would demand many batteries of furnaces for its work.

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The Aero Unit System

of Pulverized Coal again demonstrates, as in other work of human endeavor, how an original idea at first worked out by complicated and costly methods is finally simplified and perfected until it becomes a part of our every day existence.

The Unit System reduces the equipment and therefore the cost to a minimum by placing the Aero Pulverizer at the furnace where the coal is fed to the machine undried and is exhausted therefrom directly into the furnace. There are no dryers, no storage or long lines of transportation for the powdered coal, thus eliminating the hazard of fire or explosion.

Each Aero Pulverizer is designed as a complete powdered fuel unit for one furnace. They are built in standard sizes ranging from 600 lbs. to 5000 lbs. of coal per hour.

Bulletin Sent on Request

AERO PULVERIZER COMPANY
165 Broadway New York

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The Red Trail Bridge

(Continued from Page 17)

always comparatively young, e recurrent floods soon dig- ng out the deposits and sub- ituting fresh deposits at new cations. If this is correct, en the accumulations of a nsiderable period of years is arcely likely to occur, except special points. Whatever e explanation may be, the ct itself seems to be fairly ear.

The engineers took advant- ge of the fact and employed e open-well method of put- ng down the piers. However, e west shore piers, though ke the others sunk by the pen-well procedure were ealed in the clay in the dry. his was insisted upon by the . S. Bureau of Public Roads.

In order that the non-tech- ical reader may have a clear nderstanding of the process, t will be well to set forth riefly the general method. It s customary to construct a ing of steel or other material. his is built or placed on the xact site where the proposed haft is to be sunk. The under ide of this ring will usually be rovided with an edge consist- ng of a single bevel. This ring s the cutting edge. In a rep- resentative case, it will have a smooth cylindrical surface on he exterior vertical part. The evel will extend inwards and pwards from this. The char- acter of the edge is that of a wood-worker's chisel. Above and on this ring will be con- structed of concrete or other masonry a cylindrical wall. By digging round and round the edge from the inside, the cutting edge with its "well" of masonry may be made to descend by its own weight. If the soil penetrated carries water in any considerable quantity, this may give too much trouble to permit one to rely simply upon pumps. And, of course, men could not do the excavating in a consid- erable depth of water. Two courses are open, however. In accordance with one, the well is made air-tight and other modifications adopted, the object being to maintain a high-tension atmosphere in- side. The tension of the air then is so managed as to pre- vent the entrance of water through the bottom of the shaft or around the cutting edge. In short, the interior is kept dry, thus permitting workmen — "sand hogs"—to dig away the earth at the bot- tom, and so allow the well to settle further and further down. This method keeps the workmen at the digging point. By the alternative procedure, the men are withdrawn and an orange-peel excavating bucket—or some other proper pattern—is substituted. The well is left open, the excavat- ing bucket doing its work through water or not, as the case may require.

The compressed-air method is, within its sphere of appli- cation, perhaps the most cer tain of success of all shaft- sinking processes. But it is limited in respect to the depth. When 100 feet of hydrostatic head has to be blown out at the bottom of the excavation, the air tension required amounts to about 43 pounds per square inch. This is ap- proaching the limit of endur- ance for the "sand hogs." When 30 feet additional have been added, the limit has been about reached. Furthermore, the method is very costly.

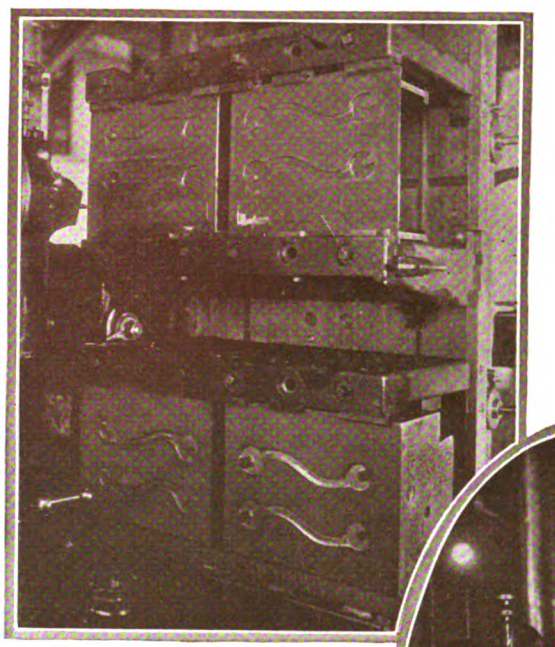
Consequently, engineers are apt to avoid the pneumatic method, if possible, and seek some alternative. For the piers of the Red Trail Bridge, the excavating was accomp- lished in the open. But not in the case of all. The govern- ment required certain work to be done by the compressed-air method.

There is one thing which happens occasionally with op- en piers, which is calculated to make the engineers thoughtful. The well of ma- sonry is liable to stick tight. This is pretty sure to happen, if the well loses its verticality. Visualize conditions when the cutting edge has gotten down 50 feet or more and is sur- mounted by an enormously heavy wall. Suppose, now, that the whole tips, because of an excess softness of the soil on one side down under the cutting edge, or because of un- equal cutting away of the soil. Not only may the whole stick;

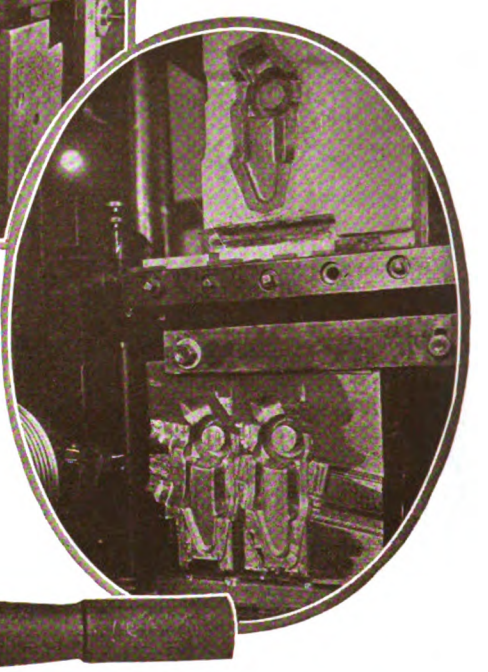
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Do It Mechanically —by the Keller Method

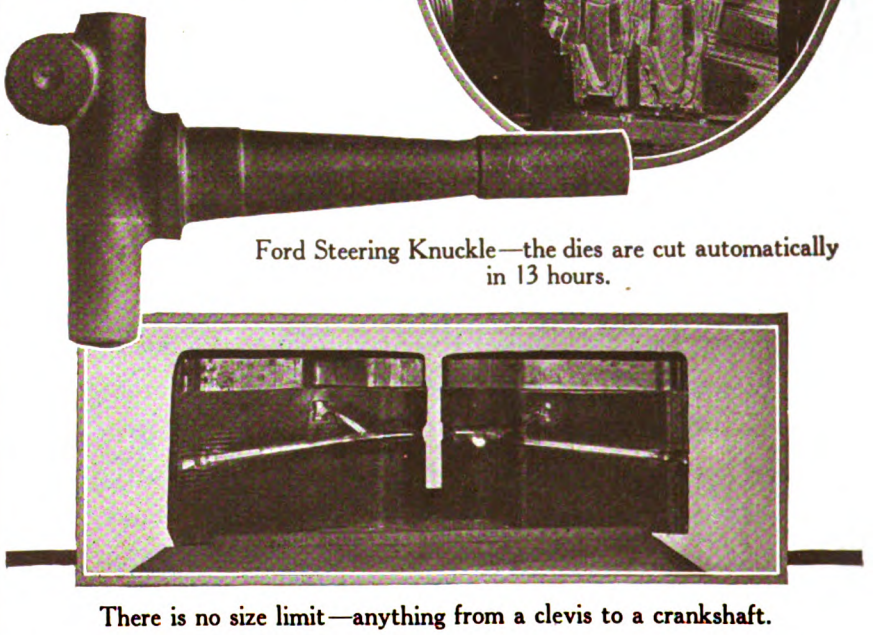
A few illustrations showing how the *drop forger* is doing it. Mod- KME ern efficiency makes hand methods obso- lete.



A large wrench manufac- turer is cutting dies like these on a Keller Auto- matic Machine in eight hours.



Intricate locks and deep cutting present no difficulty to a Keller Machine. Note how it has re- produced in steel two impressions with locks and all, from a plaster pattern—working *automatically*.



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Taylor Instrument Companies
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S-312

(*Continued from Page 53*)

but it may have to be abandoned, because of an inability to right it. One such case occurred on the present job.

The piers used as foundation structures for the Red Trail Bridge were of novel design and of large size. I speak now of the piers that stand in the river. At the base, the pier is 60 feet long. This dimension parallels the current. The width is 23 feet. This base structure standing on such a site is 14½ feet high. A steel skeleton was erected on the cutting edge. To this frame forms were attached, and the whole filled up with concrete. Reinforcement was provided at suitable points. Pockets, three in number, were left in the base structure, in order to provide for the excavating buckets.

The cutting edge itself had a bevel of 40°. The pier design is narrow above this base. Thus, above the base line, the pier narrows first to 16 feet, then to 12 and finally to 10. This last width is in fact the diameter of the two great pillars which constitu with an arch, the upper pa of the whole structure.

The shore piers consis each, of a pair of twin co umns having a diameter of 2 feet. They are 10 feet de and are provided with dredging pocket having diameter of 9 feet.

The putting down of th piers went along rather brisk ly at first. That is, they pe etrated downwards at the ra of from 1 to 3 feet per da When the clay stratum wa reached, however, there wa more or less delay because the sealing of the piers.

The reason for sealing wa this: The clam-shell excava ing buckets employed were u equal to the work of diggin this clay stratum satisfa torily. The substitution men working at the point excavation meant that th water had to be exclude This was done by sealing. I order to carry out the sealin it was found necessary to pe etrate the clay some 10 or 1 inches. This was required b

(*Continued on Page 55*)

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(Continued from Page 54)

cause the surface of the stratum was not precisely level all over, but had irregularities.

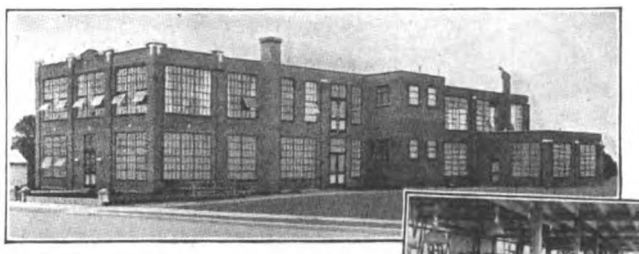
The difficulties brought about by moderate inequalities were accentuated in the case of Pier No. 3. The upper surface of the clay was found to dip. In consequence, this pier, when at a depth of 70 feet, tilted over a matter of 30 inches. In order to loosen up the clay on the high side, driving points made from old steam-boiler tubes were employed. The blacksmith closed these tubes at one end. They were then driven into the clay, and into the holes thus made dynamite cartridges were inserted. These were shot, a number at a time. After the several piers had sufficiently entered the clay to make dryness possible, and had been duly sealed and the water pumped out, excavation was resumed. That is, workmen down in the hollow piers continually dug away the stiff clay with mattocks.

The shells constituting the piers at first were constructed of reinforced concrete and made sufficiently strong to resist compressed air, in case it should become necessary during the sinking to have recourse to the pneumatic method. This procedure has already been partially explained. It may be as well to supplement the incomplete explanation.

New York City for example is so situated, particularly near the lower end of Manhattan Island, as to require excavation through water-bearing strata — sometimes through quicksand. It has become usual during recent years to carry the foundation of all very tall buildings to the bed-rock. Where water and quicksand are to be dealt with, a common practice is to use the pneumatic method. All the piers of the Singer Tower are on rock. The Municipal Building is partially on rock, partially on something else. The rock was too far down—and I understand the foundations cost $1,000,000 as it was. A kind of cabin is made on a cutting edge. That is, there is no bottom, but there are strong sides and roof. The roof is pierced and round this opening a "well" rises to the surface. An air-lock is secured to the top of the well, which may be of steel. Concrete is put round this well and thus gives weight and body to the structure. The concrete stands on the roof of the caisson, as the "cabin" is called. The man and the tools pass down through the air-lock and the men and the "spoil" pass up through the same device. When the excavation is quite finished, the interior of the caisson and the pasage-way are filled up with concrete. It was once the custom to leave the wooden caisson in. This was objectionable, because of the wood. Later, the caisson was constructed of reinforced concrete. It was thus suited to become part and parcel of the solid pier. If I am not mistaken, the piers put down for the Municipal Building, New York City, were the very first or among the very first where the caisson was itself of concrete.

To return to our Red Trail Bridge, however; the great piers out in the river are enormously strong and substantial. There is the great base, the two massive columns rising from it, and the arch connection joining the upper parts of the columns. All these constitute substantially a simple piece of masonry. There is reinforcement where needed, so that tensile strength is supplied at various points.

In the older days—that is, from about 1880 on to the end of the nineteenth century, the War Department required that bridges should, in the interests of navigation on the Upper Missouri, have a clearance of 50 feet above the high water level. This requirement, had it been insisted upon, would in the present case have constituted a very onerous requirement. The bridge would have had to be unnecessarily high and this would have added to the cost. As a matter of fact, however, the 50-foot requirement has become an archaism. It was conceived in the days when the river boats had high smoke stacks. Today, it appears that the only type of vessel that can expect to compete with the railroad and the motor truck is one that depends upon internal combustion engines. The



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erected in 47 days including entire mechanical equipment and installation of machinery.

—INTERIOR—

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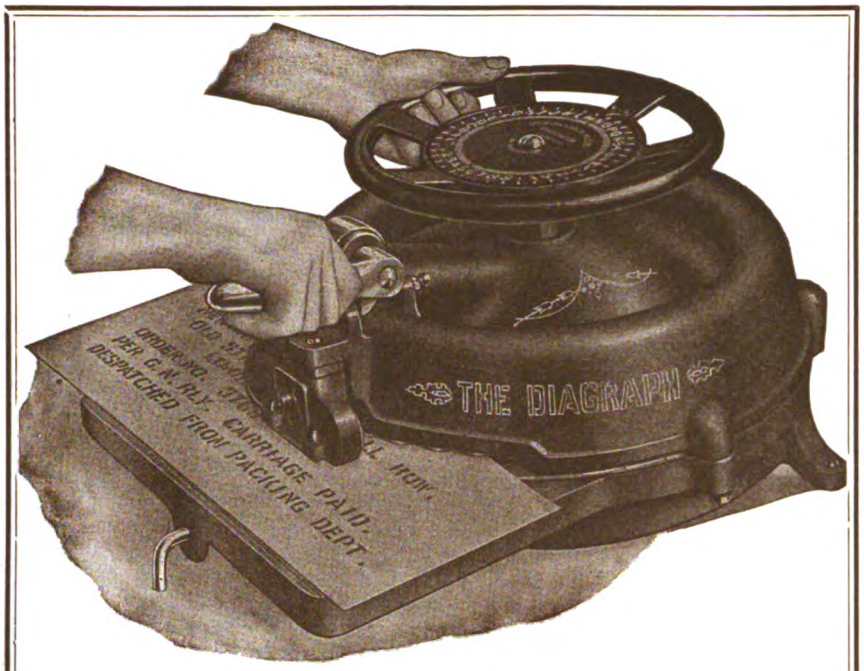
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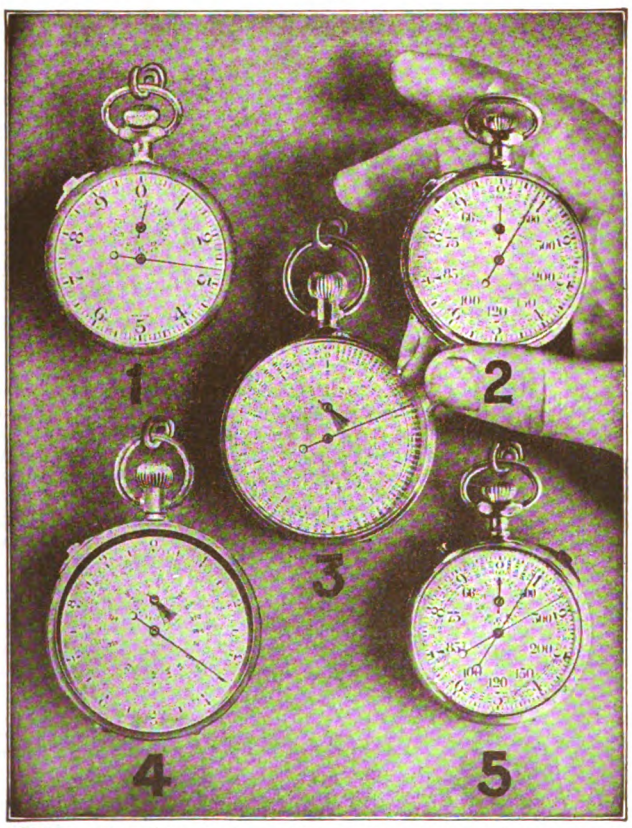
READ
"The Freight That Failed"
By Forrest Crissey

Every business man should read this illuminating article in the May 27th issue of The Saturday Evening Post. Mr. Crissey, in discussing the $100,000,000 annual freight claim losses, states that the use of stencils for addressing is a highly effective means of loss prevention. Read Mr. Crissey's article—then buy a Diagraph. Free trial in your own shipping room.

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requirement was cut down to 38 feet and might probably without risk have been cut still lower.

The Red Trail Bridge has a feature that is more or less unusual in connection with American steel bridges. About the close of the nineteenth century or the beginning of the twentieth, there was, it seems, some difference of opinion between American and European bridge engineers in respect to the question whether a pin-connected system of steel-work or a rivet-connected system was the more economical. The Americans claimed the pin-connected bridge was preferable from this point of view and the Europeans claimed the rivet-connected. It would appear as if the Americans were able to build a lighter bridge with pins than the Europeans with rivets. However, in the present case, the American engineers have used the rivet-connected system, and claim that they have produced a bridge that is more economical in respect to weight of metal than if they had employed the pin-connected system. A feature of the design of the trusses of the big spans is an attempt to approximate equilateral triangles in the arrangement of the members. Those who cross the bridge by automobile or otherwise may care to note this feature. It is also evident from one or more of the views shown herewith.

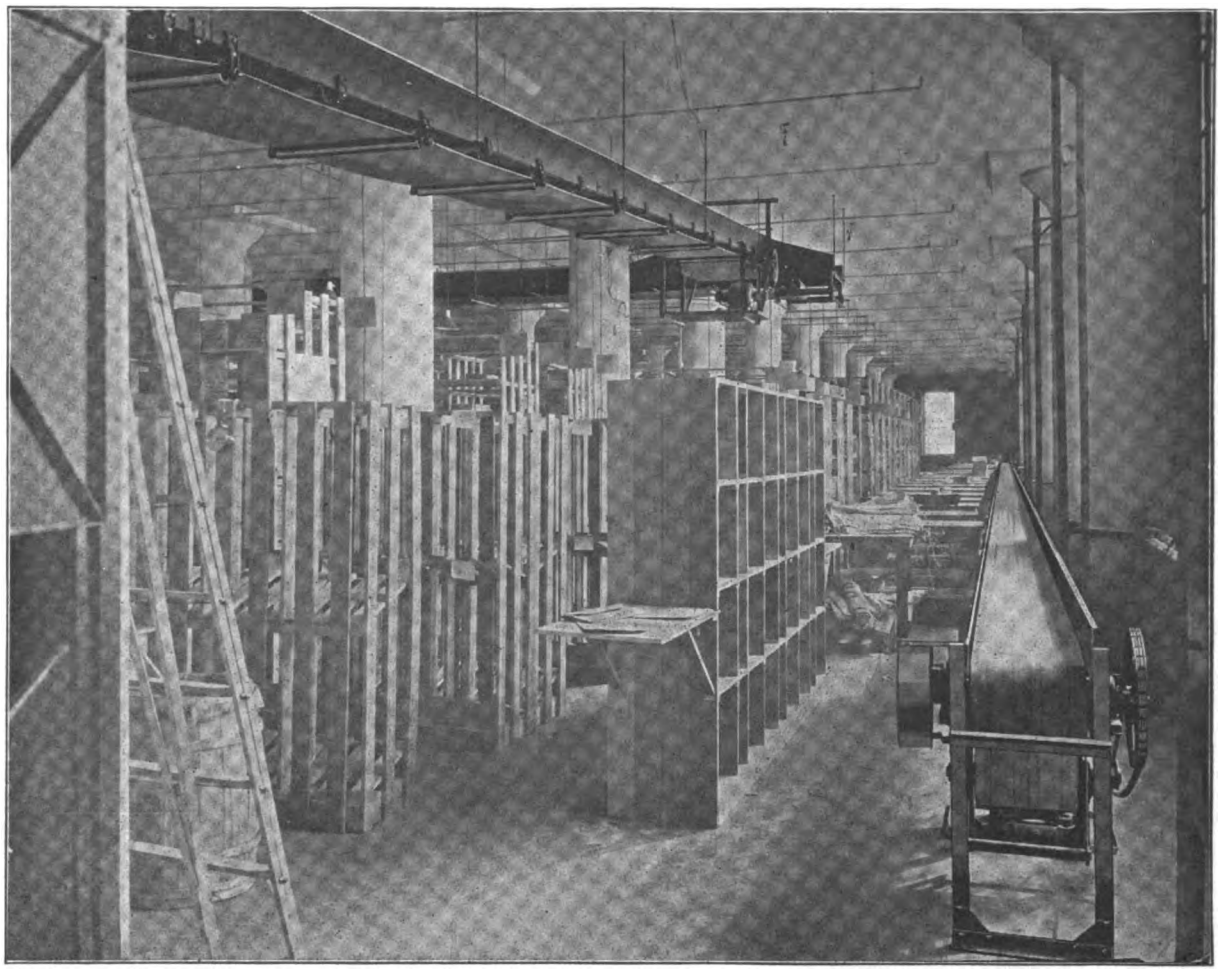
A rather unusual attitude has been taken by Capt. I. P. Baker. This gentleman is principal owner of the only company handling real commercial transportation on the Upper Missouri. Nevertheless, he is an ardent promoter of the bridge enterprise, having been active in getting the reduction of the 50-foot clearance requirement and having donated a good deal of land for the bridge. He takes the broad view that the better connection there is between the developments on the two sides of the river the more business his company will have.



One of the 183-foot towers supporting the antenna of the General Electric Company radio broadcasting station, erected on the building where the powerful transmitting apparatus is located.

Photograph by General Electric Co.

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Showing the manner in which belt conveyors can be installed. Note the conveyors hung from ceiling as well as conveyor to the right placed on floor.

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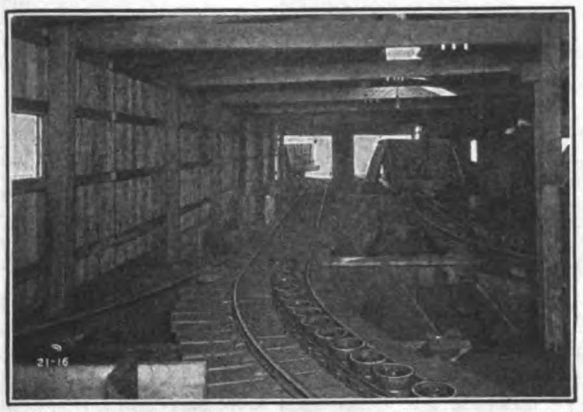
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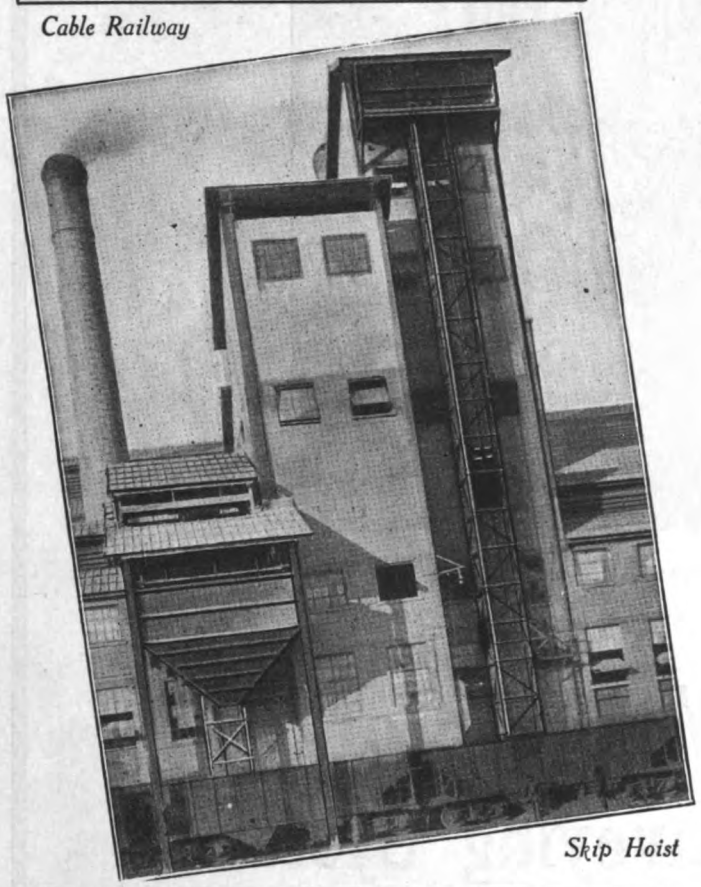
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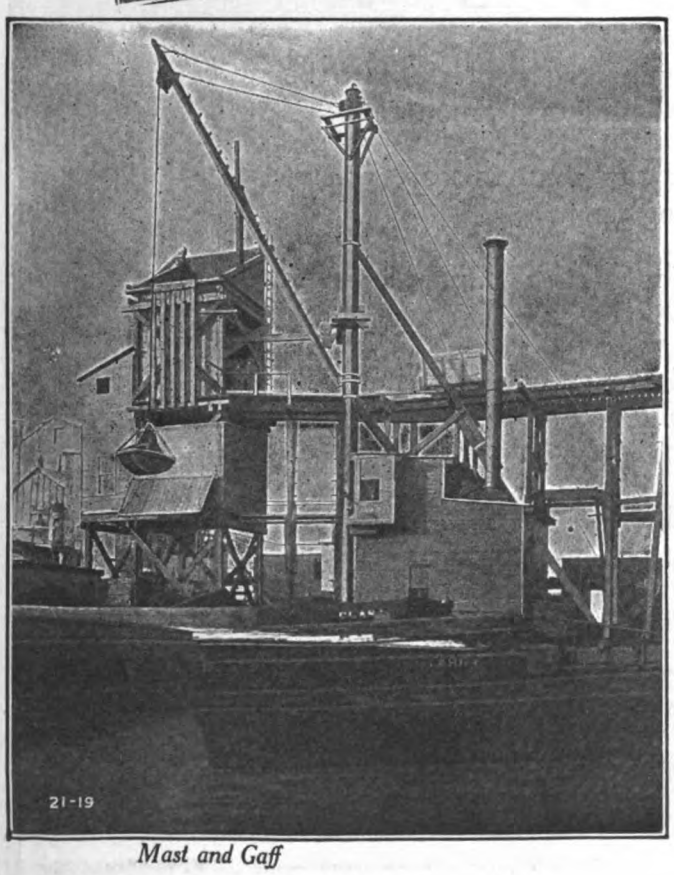
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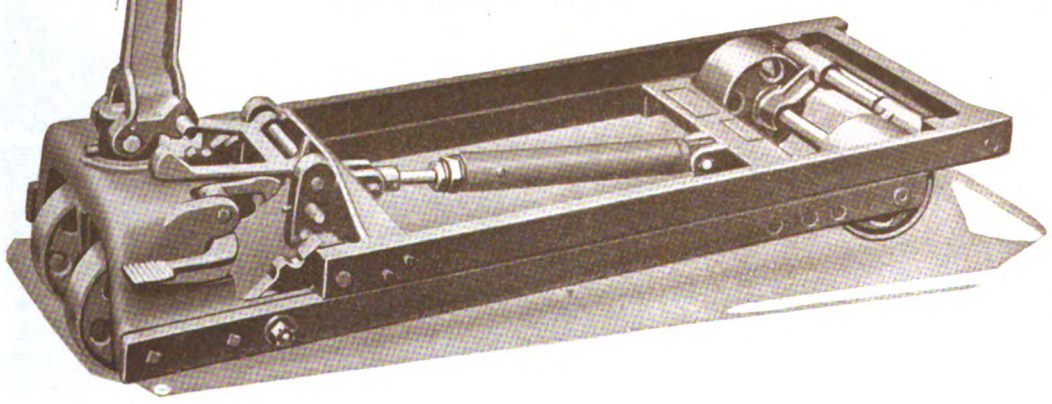
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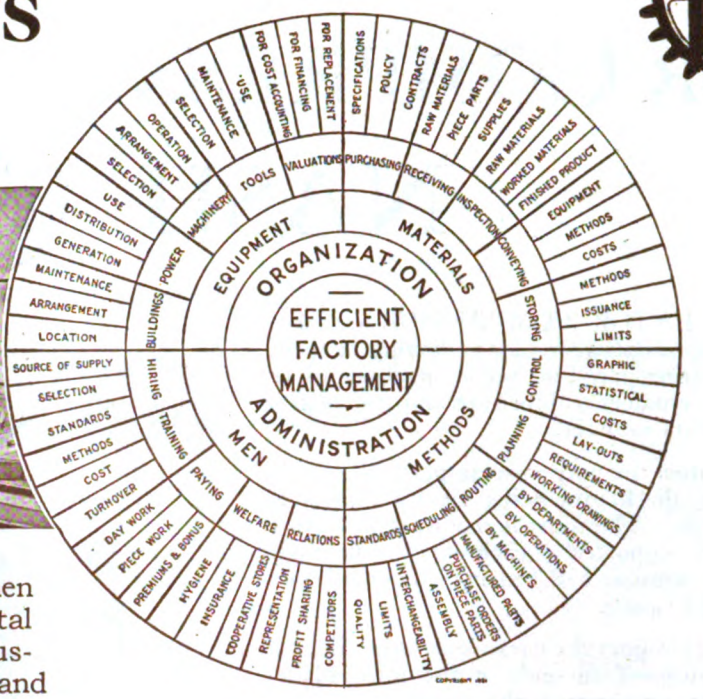
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Originators *of the* "through ticket" *system for* moving loads

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If the Managers Should Strike





The words "Capital and Labor" are on everybody's lips. To hear people talk you might suppose that these two economic groups constitute the only factors necessary to the successful prosecution of an industrial enterprise.

You don't hear much about the third, and equally important, party to any industrial undertaking, "Management." And yet without "Management," neither Capital nor Labor could function successfully. If the managers should go on strike, the wheels of industry would first slow down, and then stop altogether. Production would cease. The world would starve, as Russia, which has rid herself of her managing class, has been starving.

Managers are Scarce

Capitalists can always be secured to back a manufacturing enterprise. Laborers can be had aplenty to do the work. But managers—men who have the brains and the training to plan and carry on a great industrial undertaking—managers are hard to find. There is a serious shortage of executives in industry.

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The original high efficiency is maintained indefinitely in continuous service.

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No expert attendance is required as there are no adjustments to make. The cost of upkeep is negligible.

Hytor compressors are quiet in operation.

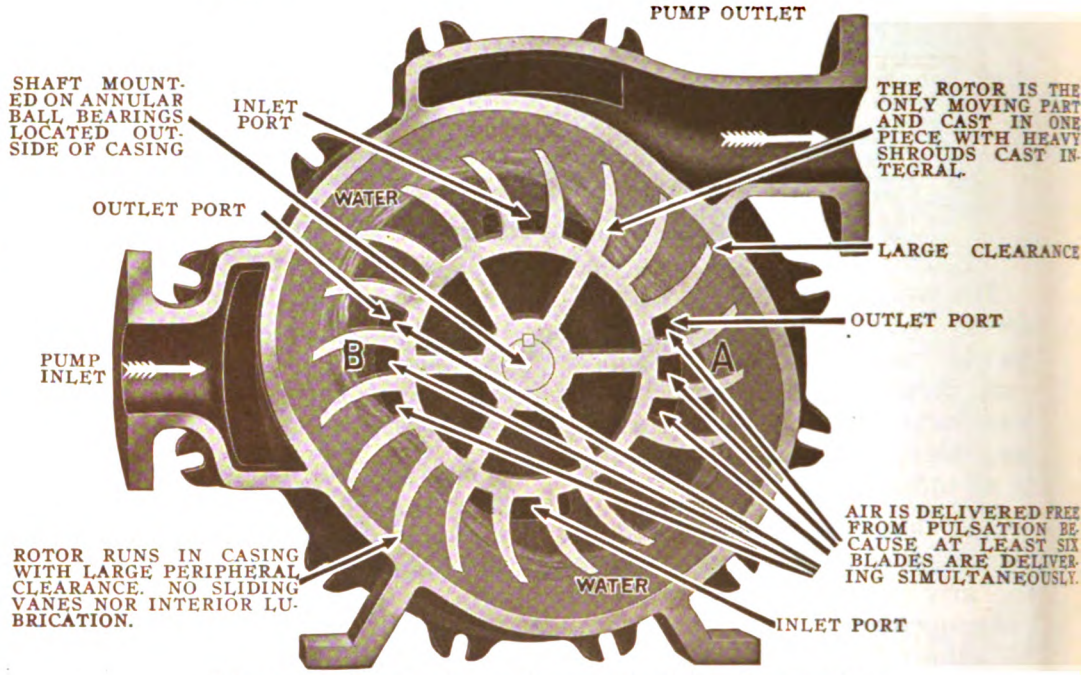
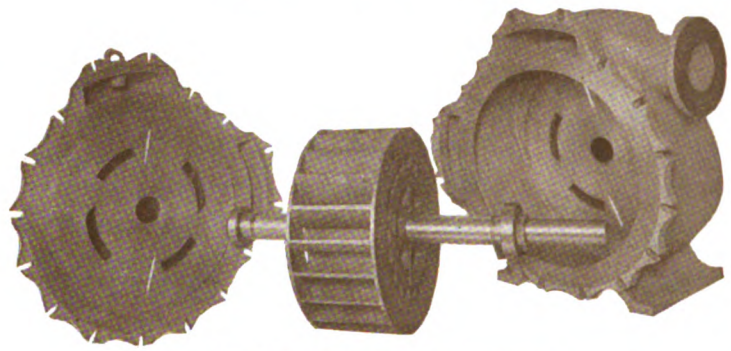


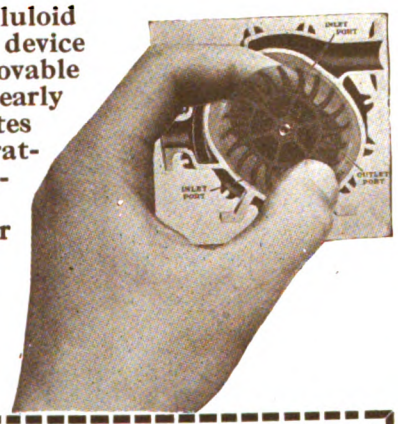
Diagram illustrating unique principle of operation



A ROTOR in hydraulic balance revolves freely in an elliptical casing filled with water. The water, turning, with the rotor, and constrained to follow the casing by centrifugal force, alternately recedes from and is forced back into the rotor, twice in a revolution. As the water recedes from the rotor it draws in air through the inlet ports. When the water is forced back into the rotor by the converging casing, the air is first compressed and then discharged through the outlet ports.

All the parts of the Hytor

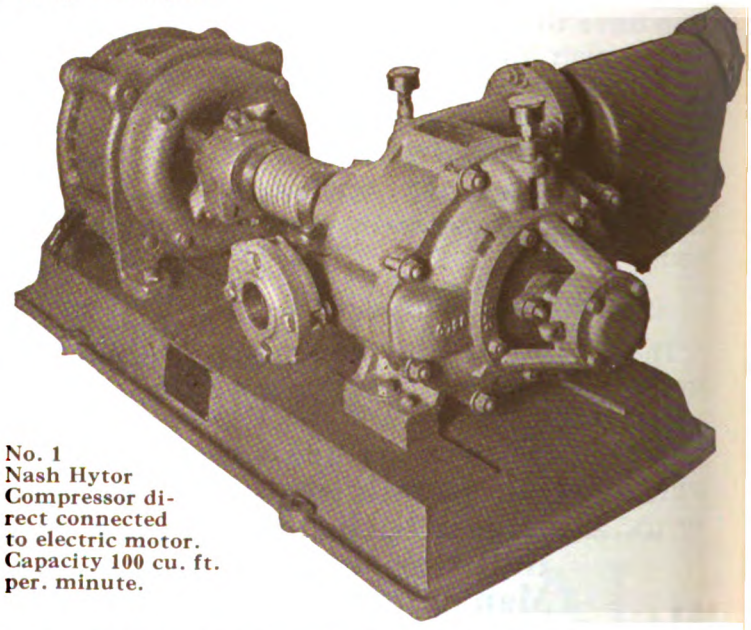
This celluloid graphic device with movable rotor clearly illustrates the operating principle. Send for your copy.



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EDITORIAL

Who Pays the Bill?

IN CHINA, coolie laborers can be hired for one cent an hour—ten cents for a ten-hour day. In many parts of that country coolies are the only source of power; there being no development of water power, no steam boilers and engines, except in a very few of the more progressive sections.

Naturally, in a progressive country like ours, we look down rather tolerantly upon the slow, wasteful, costly methods employed in the Land of the Dragon. We have even pointed with pride to the fact that it takes some thirty-seven "coolie-power" to produce one horsepower, at a cost of over $1,300 a year—as compared to a cost of little more than $60 a year for one horsepower produced by American methods.

Among other things discarded by the more enlightened races, the Chinese have retained the guilds. One of these guilds—that of the tea and silk packers—found, early this year, that they were not getting enough money for their work in proportion to their increased living cost. But with this knowledge, they had also the novel and refreshing conviction that their work was too important to a great many other people, to allow of its being interrupted.

In this situation, where the obvious remedy would have been a strike to focus attention on their troubles, the tea and silk packers' guild turned instead to advertising. By means of paid space in the newspapers, the guild told its patrons just why these workers should be paid more for their work. These advertisements made their appeal very respectfully, but convincingly. Moreover, they showed a thorough appreciation of the fact that the wages came, not from the employers, but from the consumer—and the men kept right on working.

The net result of all this was that the workers, having a legitimate case, obtained the increased wage without having lost a single day's pay through a strike; while the employers lost nothing at all, and the consumers suffered no inconvenience and were perfectly willing to pay the small, reasonable increase.

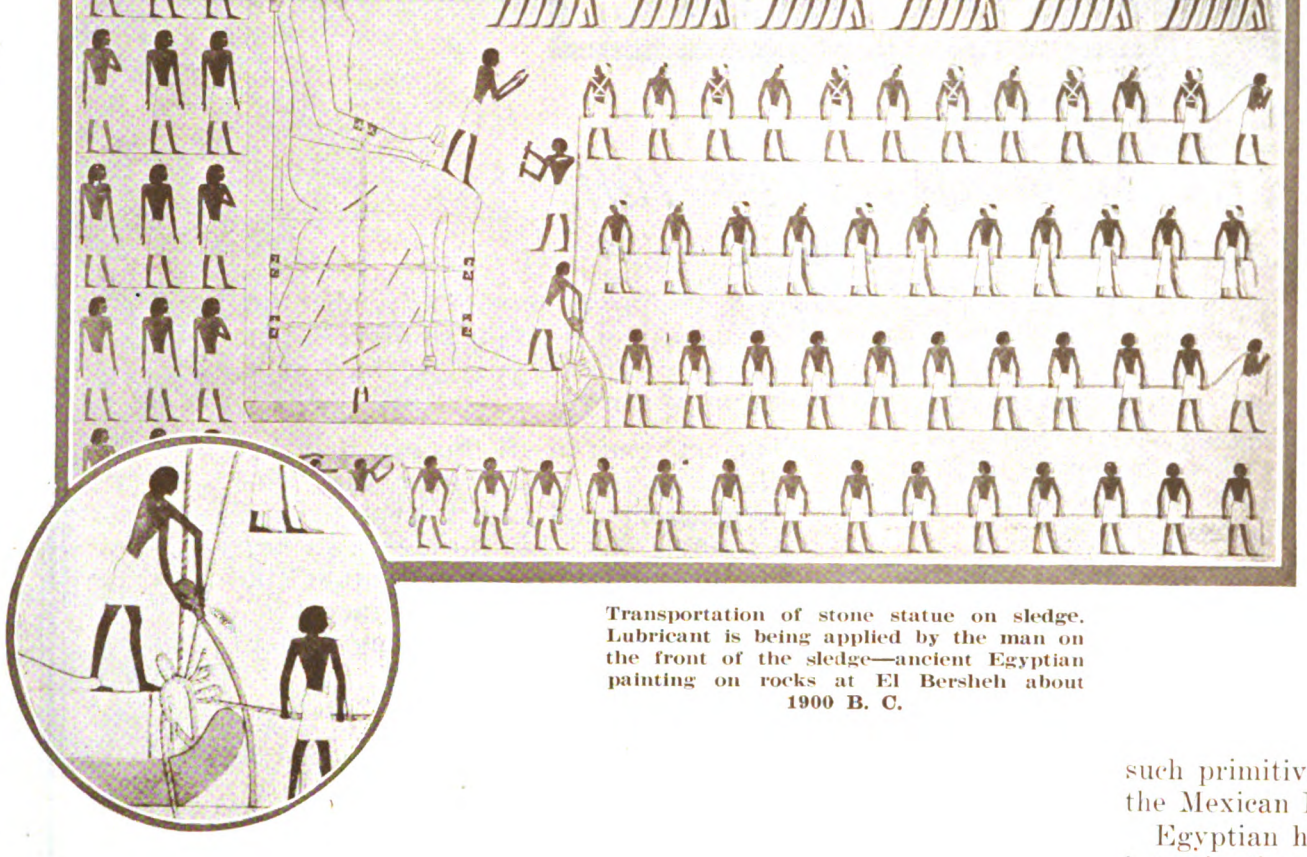
Here in America, a handful of railroad operators and coal mine operators and a few hundred thousand shopmen and coal miners have been wrangling for many months about questions essentially similar to the one which confronted the tea and silk packers of China. Being more enlightened than their brothers of the Orient, our miners and shopmen went on strike to force the issue. Already these strikes have cost the country not only untold inconvenience, but millions of dollars; and, no matter what the outcome, no party to the dispute can possibly receive benefit in proportion to what it has already lost through the strike.

In China, as in this country, the greatest sufferer from a strike must always be the consumer; and the consumer has neither organization nor leadership. But here, as in China, both worker and employer are organized. The difference seems to be that in the benighted Land of the Dragon both labor and capital look upon the consumer not as legitimate prey, but as the really essential factor—the one whose interests are paramount; the one whom they both must serve in order to market their wares.

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The Evolution of Anti-Friction Bearings

By Philip C. Gunion



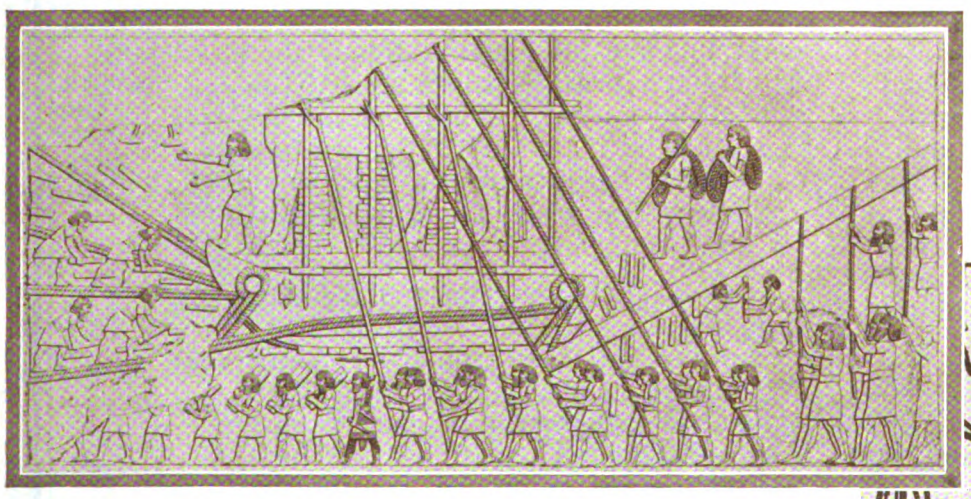
Transportation of stone statue on sledge. Lubricant is being applied by the man on the front of the sledge—ancient Egyptian painting on rocks at El Bersheh about 1900 B. C.

IN THE past two decades t term, "anti-friction be ings" has come to have specialized meaning and d notes bearings of the ball a roller types. Correctly spe ing, however, an anti-fricti bearing is one designed to do way with or lessen friction, a careful examination of t bearings in use through those ages of which we ha historical knowledge, will i dicate that every bearing e used was the result of an deavor to lessen friction.

The historical period of world dates back to about 5 B. C. and although there is doubt that many great thi were being done at the da of history, the records are v hazy. However, some insi into the mechanical methods use previous to this period be gained by observation those prevailing today am such primitive races as the Eskimo tribes the Mexican Indians.

Egyptian history affords a rich field for investigation of the origins of art, political ence and military science because the anci Egyptians have left behind them on their mo ments paintings and sculpture which portray great deeds in the lives of their rulers.

Inasmuch as the first engineering work any importance was the erection of public bu ings, it is very singular that we find no illust tion of mechanical means used by a people have left so many proofs of their skill in th

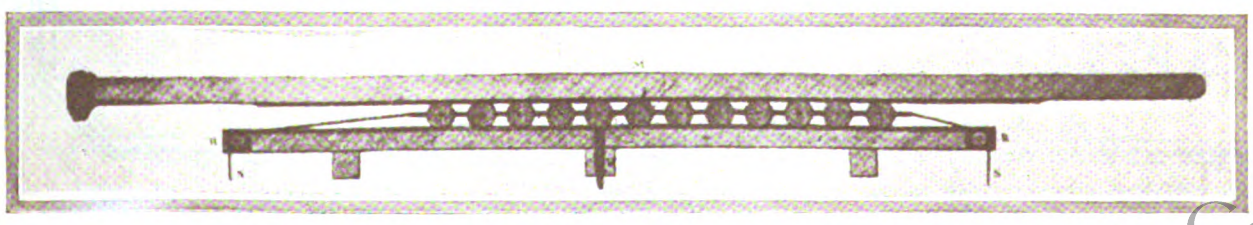


Using rollers and lever to move statue—Assyria about 875 B. C.

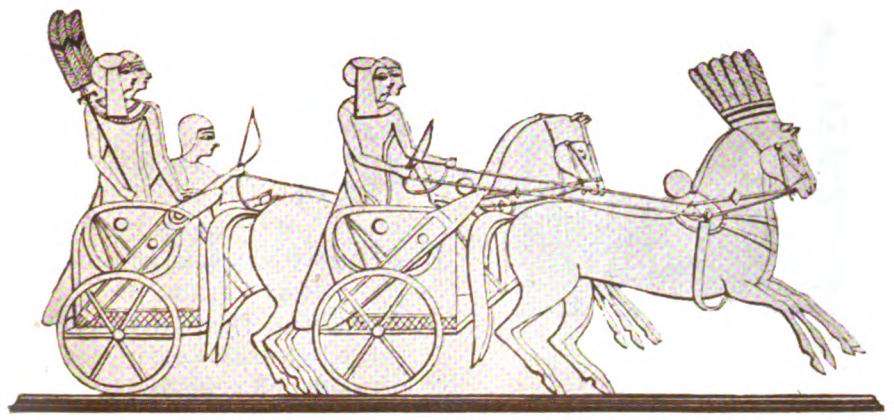


Crude form of wheel, probably a slice of tree-trunk —Chaldea, about 3500 B. C.

Use of rollers to move a heavy load easily—Roman battery ram about 50 B. C.



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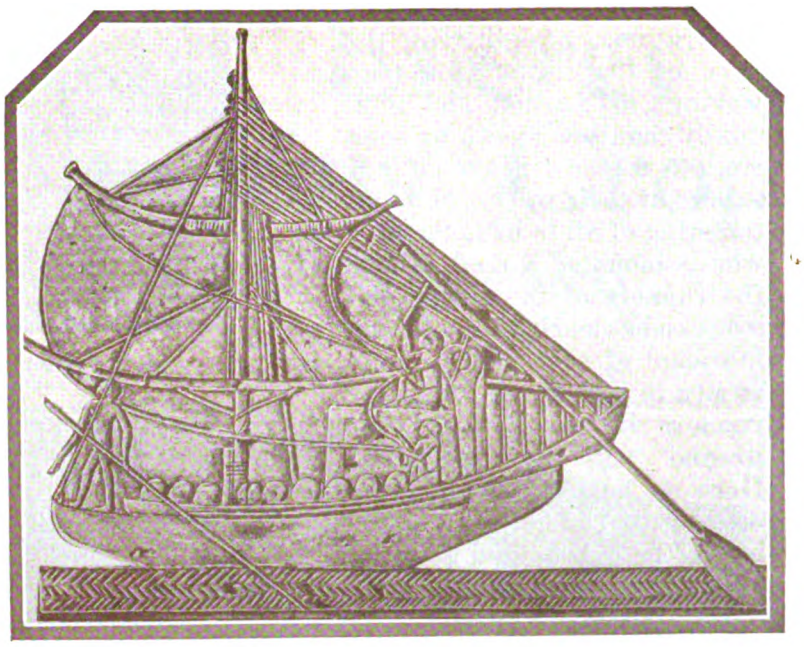
Light wheel spokes similar to modern buggy wheel, used on Egyptian war chariots—portrait shows the sons of Rameses the First. About 2000 B. C.

matters. Egypt was the primeval seat of what may be called material civilization and many arts and inventions were known there when the rest of the world was still in ignorance and barbarism.

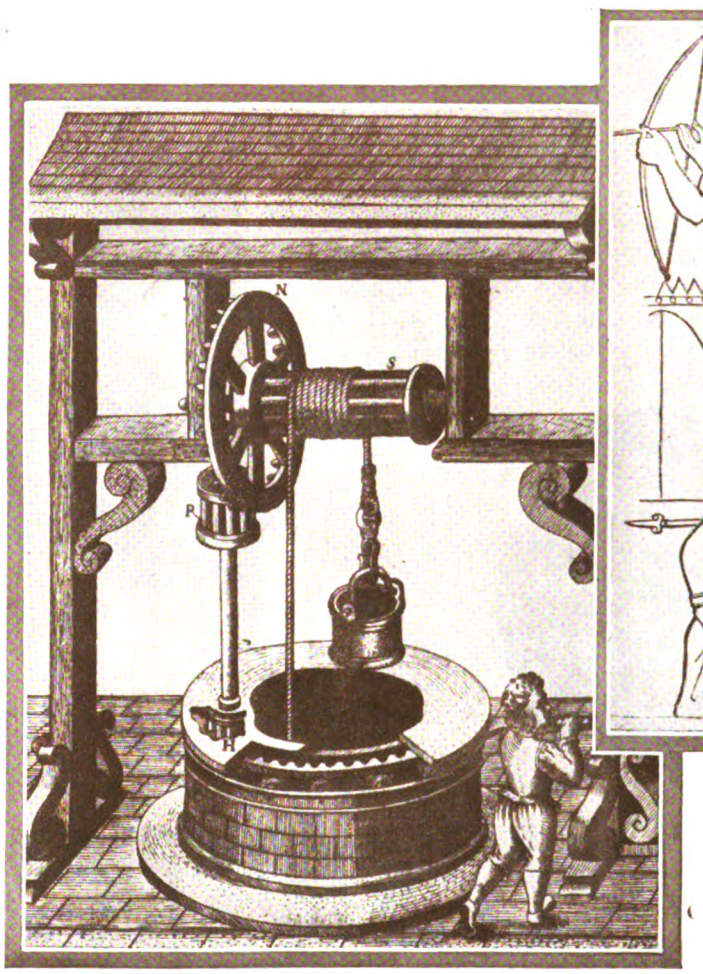
The first question that presents itself when we consider the building of the gigantic Egyptian monuments is the transportation of the enormous blocks of stone. At first these blocks were probably dragged along the ground from the quarry to the place where the structure was to be made. It is at once apparent to us that this meant the exertion of a large amount of energy on the part of the laborers and it was probably physically apparent to them long before their mental processes evolved the first step towards the decrease of friction by the use of bearings.

This first step was no doubt the use of a rude sledge consisting of a platform to support the block of stone and mounted on two runners. This constituted an anti-friction bearing because the load was concentrated on the narrow surfaces of the runners and these surfaces were smoother than the surfaces involved when the block was dragged on the ground.

Fortunately, we have clear evidence of the existence of this first type of anti-friction bearing. A picture existing today painted on the rocks in a grotto near El Bersheh shows the method of transporting a huge statue of solid stone twenty-four feet in height. This statue was mounted on a sledge, and attached to the runners are ropes dragged by eighty-eight men, each



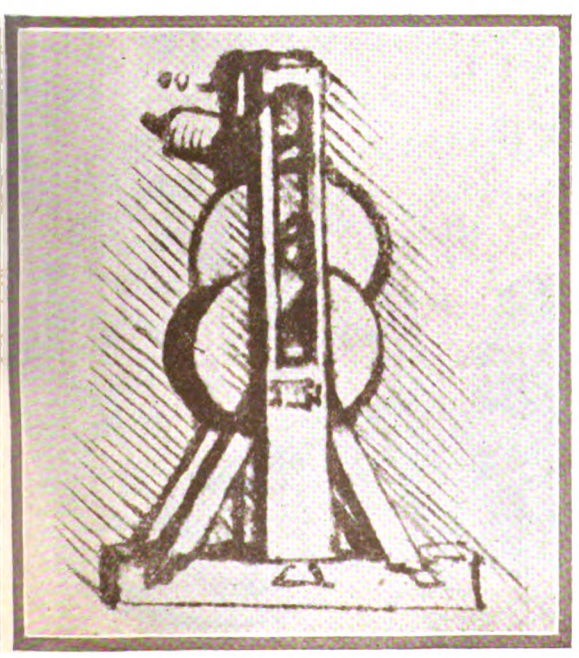
Showing dead-eyes on Egyptian ship, 3500 B. C. The dead-eye is the forerunner of the pulley.



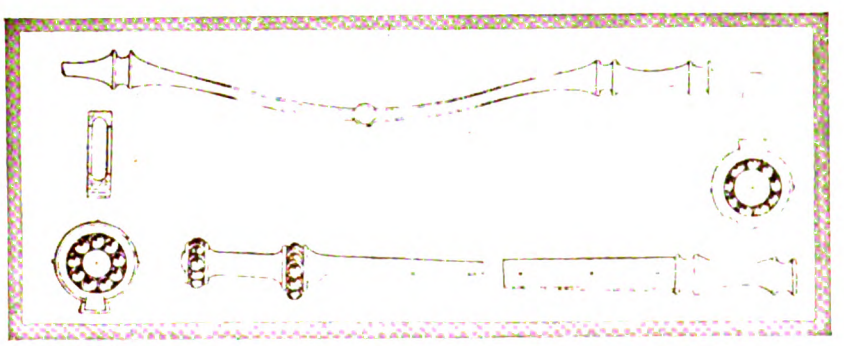


The simple pulley installed; as shown on a fragment from Nineveh, of about 875 B. C.

Rollers used as trunions under a well curbing, where motion around the well was transformed into power to pull up the bucket. About 1500 A. D.



Sketch made by Leonardo Da Vinci, the Italian engineer and artist, showing a device whereby the axle of one roller was carried on the periphery of another. Probably a speed-reducing device. 1500 A. D.

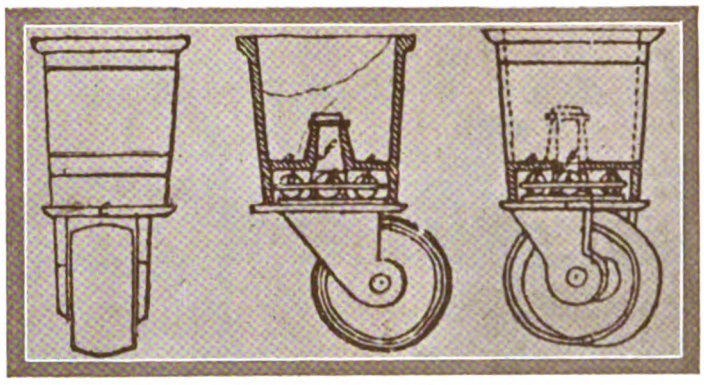


Ball-bearing wagon axle, English patent 2000, taken out in 1794 by Philip Vaughan.

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man shown in profile according to the Eqyptian method of illustration. Standing on the knee of the statue is a man waving his arms and evidently chanting a working song similar to the "heave-ho" of sailors at their work. Most interesting of all to us is the man who is mounted directly above the runners of the sledge and who can be clearly seen pouring lubricant of some nature from an urn in such manner that the runners in passing over the ground will be lubricated. Here we have an anti-friction bearing that is not only superior to the old method of dragging the stone on the ground but is lubricated as well.

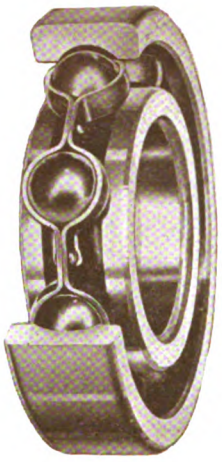
There exist today two analogies of this first type of improved bearing. First, the sleds used by the Eskimo Indians of the Arctic region. The runners are wrought from driftwood or whalebone and shod with strips of walrus ivory fastened by wooden nails or lashed on with rawhide. When the vehicle is ready to start the Eskimo inverts it, fills his mouth with water and blows it along the runner where it freezes, filling the cavities and lubricating the surface. It only remains for him to polish the ice-crusted runner with his mitten to obtain a surface which in contact with smooth ice presents a bearing which probably develops less friction than the highest types of modern bearings.



Ball-bearing casters for furniture, English patent 4481, taken out by Joseph Harcourt in 1820.

The second analogy is the method used by the Khasi hill tribes of India in transporting the huge monuments of solid stone which they still erect. The slabs of sandstone are quarried by means of wedges near where they are to be set up. Some of these slabs weigh as much as twenty tons. They are moved on a cradle made of strong curved limbs of trees, smooth and rounded so as to present little surface to friction. To put it in other words, this cradle as compared with dragging the stone on the ground, is an anti-friction bearing.

It is evident that logically the next step in the improvement of bearings was first the use of rollers placed on the ground under heavy loads, soon superseded by the primitive wheel. Ancient history, and observation of the wheeled vehicles in use by the primitive tribes of Mexico today, indicate that the first wheel was a circular slice from a tree trunk with a hole drilled in the middle for the reception of a rude form of axle. Here we find that they concentrated the load still more and carried it on a surface of small area which could therefore be made of superior material. Their object was, of course, to get away from the large amount of friction which existed between the ground and the runners of a loaded sledge.

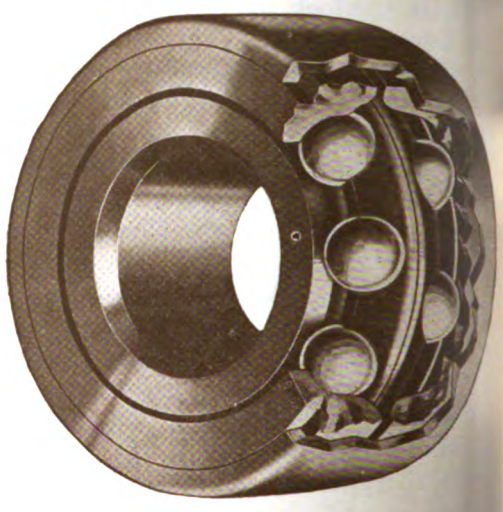


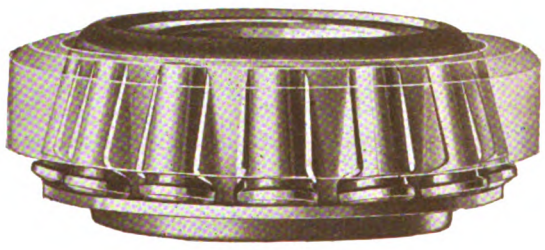
We find, however, that the wheels of ancient Egypt were not like the clumsy contrivances of unenlightened tribes of today but more like our own. More than four thousand years ago the Egyptians had chariots of war. A picture of the sons of Rameses the First shows them in a war chariot equipped with wheels having six spokes radiating from a hub which turned on an axle and was held in place by a linch pin through the axle.

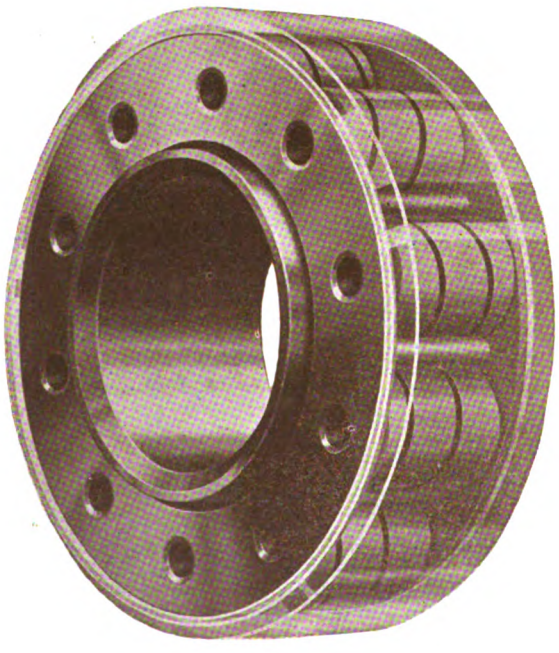
Wheels and axles of an improved nature were long known in Britain, for Cicero expresses the opinion that there was little in the Island worth the trouble of transporting to Rome except the British war chariot, which

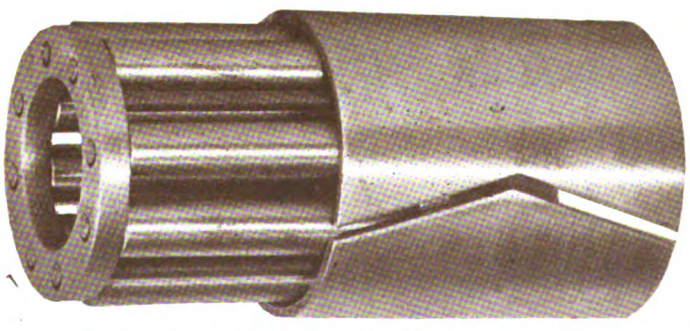
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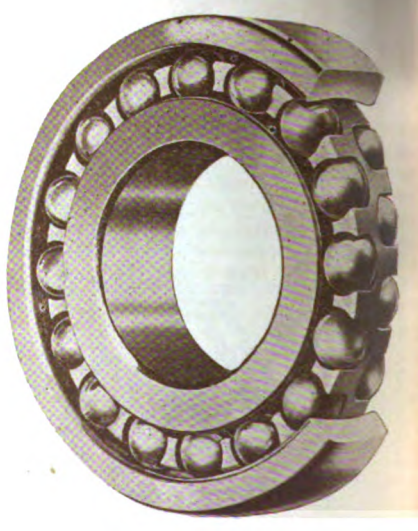












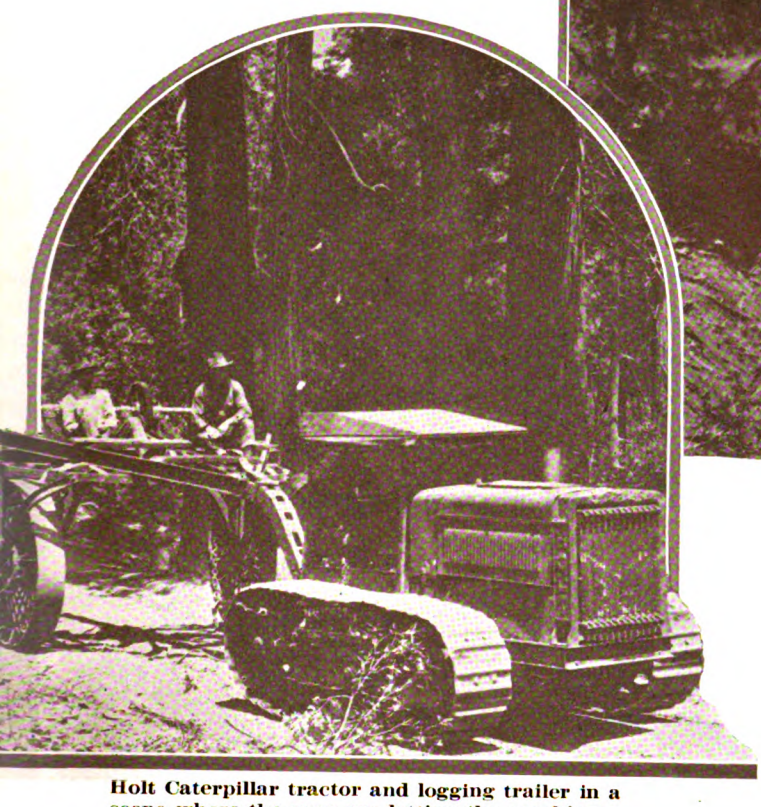
Modern forms of ball and roller-bearings for machinery applications of all kinds—1922.

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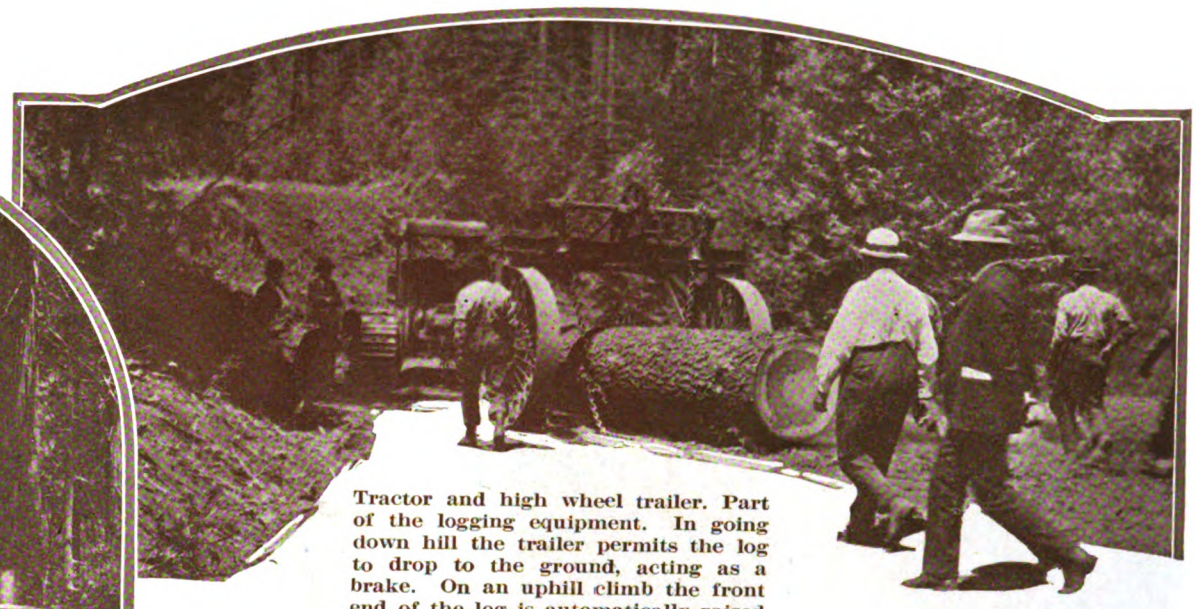
Harnessed Mountain Energy
Harvesting the Mountains' Crop

Hydro-Electric Power Applied to Lumber Operations

By Arthur W. Ford



Holt Caterpillar tractor and logging trailer in a scene where the men are letting the machinery do all the work.



Tractor and high wheel trailer. Part of the logging equipment. In going down hill the trailer permits the log to drop to the ground, acting as a brake. On an uphill climb the front end of the log is automatically raised from the ground thus lessening the drag.

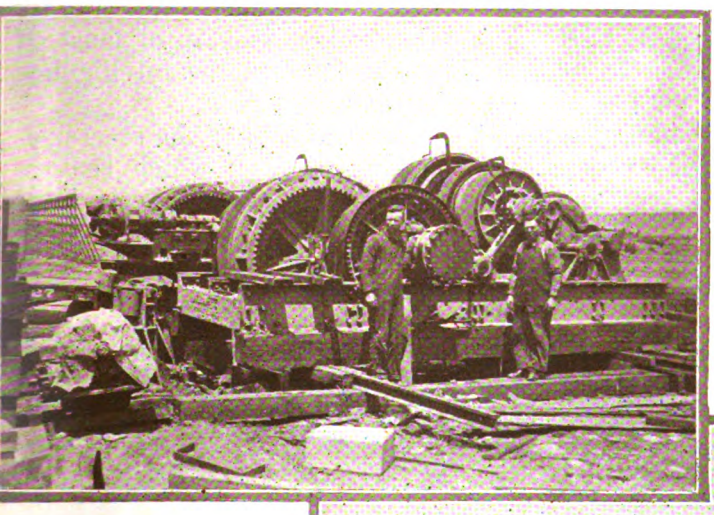
WATER power, tumbling down steep mountain slopes, converted into electric energy and transported through copper cables to other mountain ridges, is engaged, near Oroville, California, in harvesting virgin timber, the crop of the mountains.

Again, this mountain energy is transported from the hydro-electric plant in the canyon of the Feather river to Oroville where the big logs are assembled. Here, through the use of 133 electric motors, the timber crop is fashioned into lumber of lengths and dimensions for buildings required by mankind.

The operations are those of the Hutchinson Lumber Company, a West Virginia concern with approximately eighteen years experience in lumbering in West Virginia, North Carolina, and Kentucky.

From the standpoint of the use of electric power in both its woods and mill operations, the plant of the Hutchinson Lumber Company is probably the most modern in the United States. The mill was given its

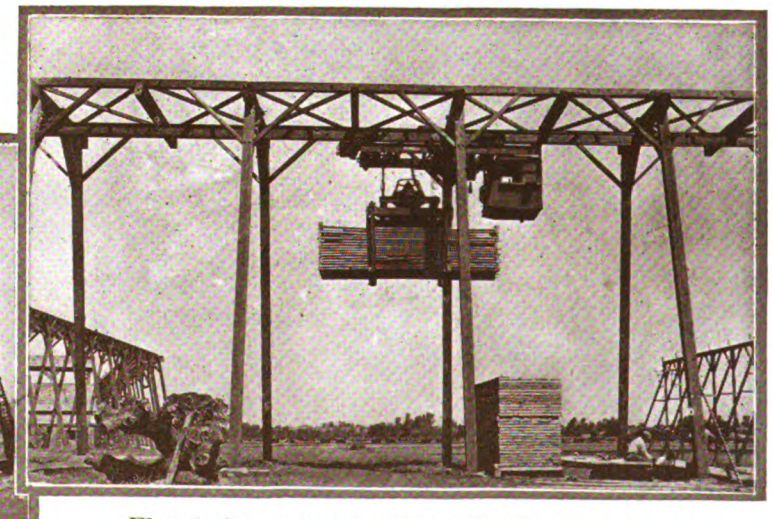
(Continued on Page 59)



iant electric donkey, waiting shipment into he forest. The wind-ass over which the log-ing cable operates is urned by a 300 horse-ower electric motor.



California White Pine and Sugar Pine logs. These logs are 32 feet in length and stretch practically the entire length of a standard sized flat car.



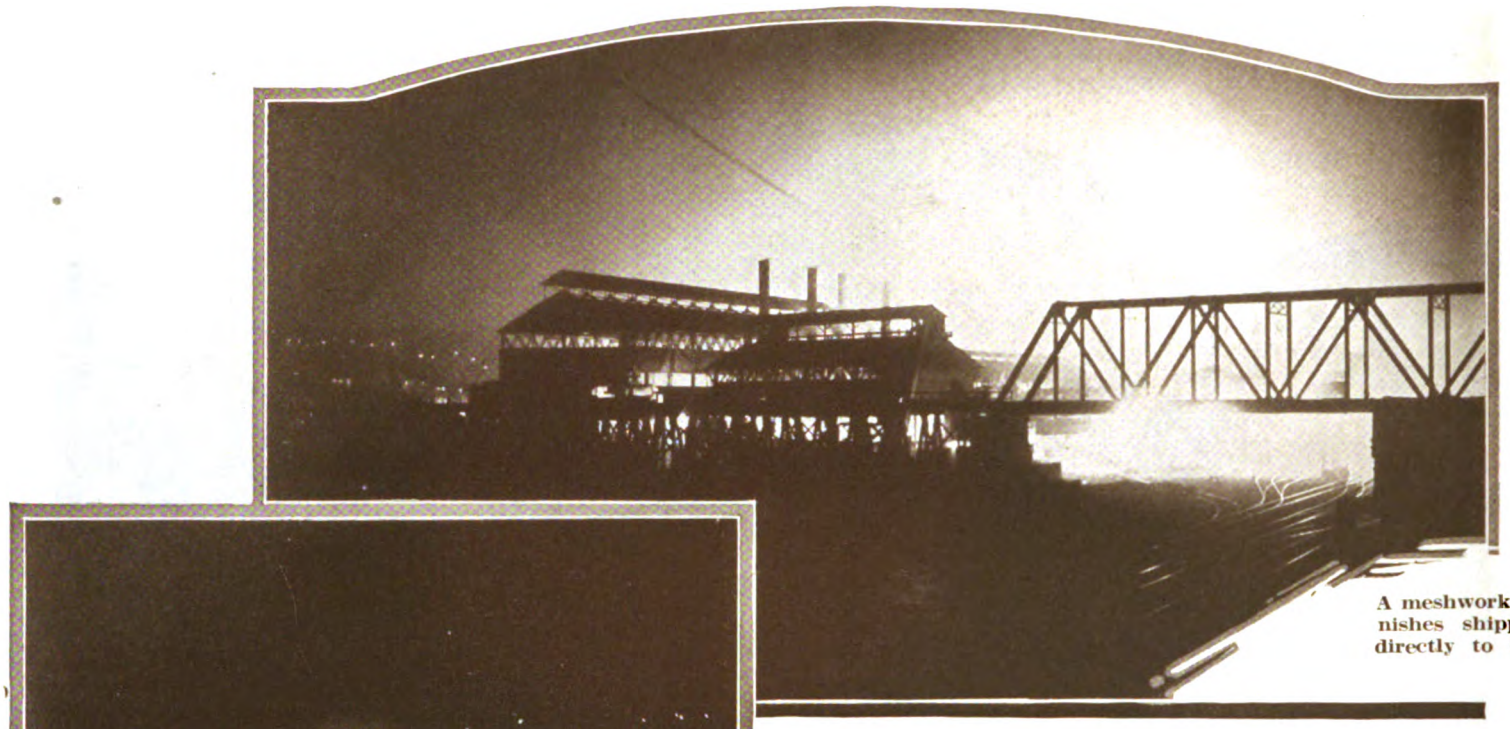
Electrically operated monorail car carrying load of lumber from green sorting shed to yards.

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Night in the Steel District

The Angry Red Glare that Means Tonnage

(*Photographs by Vander Weyde*)



A meshwork of railroad tracks furnishes shipping facilities leading directly to the great steel mills.



A busy scene at the great converter of one of the big steel works, Bessemer, Pa.

SKY-SCRAPERS, bridges, ocean greyhounds, motor trucks—all dependent on Steel. Steel, which in some form enters into almost every phase of this mechanical age. In romance, in every day manufacture of necessities, in far-sighted statesmanship and in sordid politics—in all of these, Steel has played its part. And the story of steel is not a finished chapter, but a story without end; a romance in itself, and at the same time a fact-story which is still in process of revolutionizing civilization.

In the manufacture of most commodities there are parts or processes—little "light touches"—which relieve the sombreness of the whole. Even in the highly specialized quantity production of motor cars, the general impression is colored by the final product, lightened by the evident kinship of most of the work with the intelligence of man.

In the heart of the steel-producing district, which centers about Pittsburgh, it is the total



A blast at the Carey Steel Works in Homestead, one of the great steel suburbs of Pittsburgh.

A night view of work at the mills in McKeesport.



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The steel mills are in full blast by night as well as day. This view shows the important steel works at Homestead, Pa., and forms the subject of our cover for this issue.



Railroad bridges which carry trains into the heart of the mill district.



A Bessemer converter at work at night. (Bessemer, Pa.)

of these relieving touches most impresses the observ- The product—steel, in bil- bars, rails, plates—pours h to meet the incessant de- id for "tonnage." The le thing is so stupendous as ake man seem a pigmy. It s though the whole vast ag- neration of furnaces and hinery, inanimate mechan- created by man, had be- e animate—a relentless, y-headed dragon which must serve but cannot lly control; a monster whose incessant hunger-cry is "Tonnage—more tonnage."

Cold, somber, smoke-shrouded by day; it is only at night that the monster appears in all his colorsome, awesome majesty. Roaring his defiance, licking the low-hanging clouds with tongues of blood-red flame; blowing his hot breath on the toiling, sweating human ants that serve him; occasionally reaching out and engulfing one in his incandescent maw—this is the dragon which man has created—this is Steel.

(*Continued on Page 31*)

The great steel works at Homestead, Pa.





A blast in progress at the great mills in Wilkinsburgh.

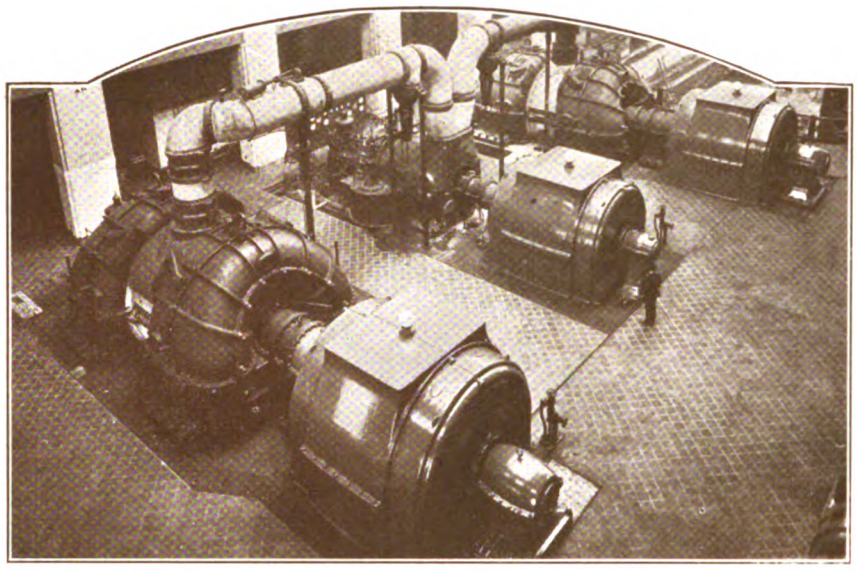
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Getting One Hundred Cents Out of the Power Dolla

A Further Attack on the Thousand-and-One Wastes that Dissipate Our Coal Supply

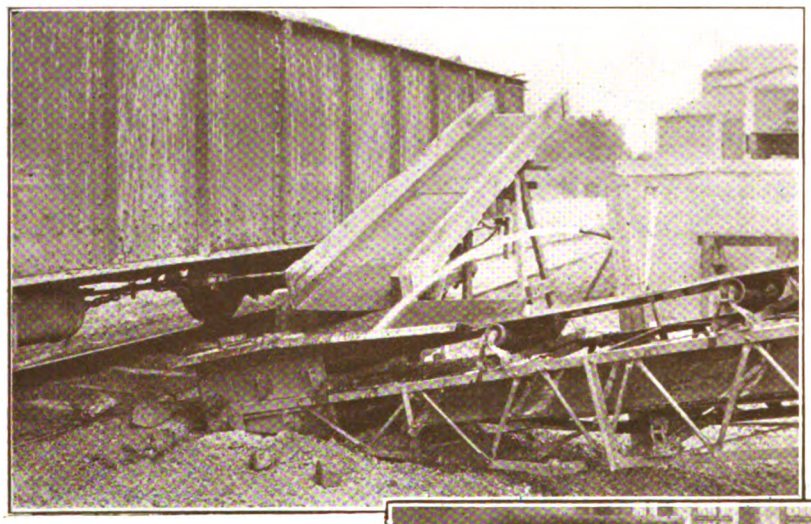
INEVITABLY, as one goes more deeply into this question of industrial power, he is impressed by two outstanding facts: the immense amount of capital tied up in machinery solely for power production; and the immense amount of waste involved in present day practice. If it were not for the first of these two—the amount of capital invested in existing power plant equipment—engineers could probably cut the wastes and inefficiencies in power generation by one-half.

But it takes time and labor and thousands of dollars to equip a power plant: and if, tomorrow, new discoveries result in machinery much more efficient, that does not mean t we can afford to scrap the isting equipment and write the investment; at least not less the saving is so great a absorb the loss in a short riod of time. An instance this kind actually arose in case of the Ford Motor C pany. With the completion its River Rouge Plant stupendous industrial which is now being deseri for the first time in a series articles in *Industrial Mana ment*) the Ford Engineers that they can supply the po requirements of both the and the older plant, from new power station. In fact, older factory can be supp



A 60,000-K. W. installation at the Duquesne Light Company, Colfax, Pa. The second unit is now being installed and the plant will eventually contain six units of this size. Only one other generator of this size has ever been completed and put into operation.

Dwight P. Robinson & Co., 125 East 45th St., N. Y.



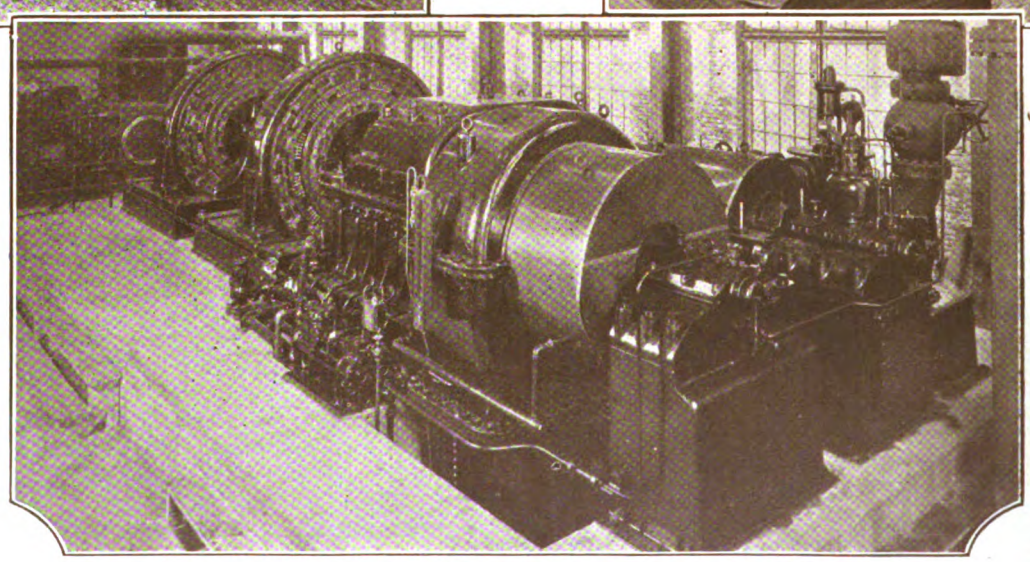
A power plant at Moosehart, Ind., has abundant space for coal storage. The coal is piled in semi-circular piles so arranged that a series of conveyors can be set to reach any pile. The conveyor on the left has its wheels set for "fanning," or in other words making one of these semi-circular storage piles.

Barber-Greene Co., Aurora, Ill.



A simple but effective metho of keeping the dust dow while unloading coal is shown in the above picture. The coal is dumped into the hop per of the conveyor and re ceives a good bath before it goes up the belt. This elim inates practically all dust and interferes in no way with the operation of the machine.

Barber-Greene Co., Aurora, Ill.



This unit in the plant of the Marquette Cement Co., is one of the largest direct current, turbine driven generators ever constructed. Its capacity is 3,750 K. W.

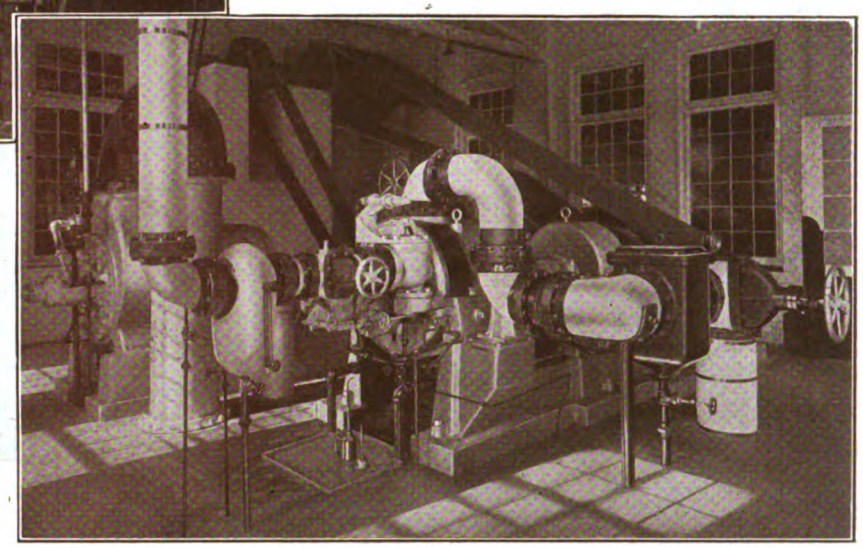
De Laval Steam Turbine Co., Trenton, N. J.

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A modern control room where the energy generated by steam and turned into electricity is distributed for use. This installation is at the Duquesne Light Co., Colfax, Pa., and represents the last word in convenience and efficiency.

Dwight P. Robinson & Co., 125 East 46th St., N. Y.



A mixed pressure condensing turbine belted to the same line shafting from which it receives its low pressure steam. Should the engine fail the turbine would automatically take the entire load.

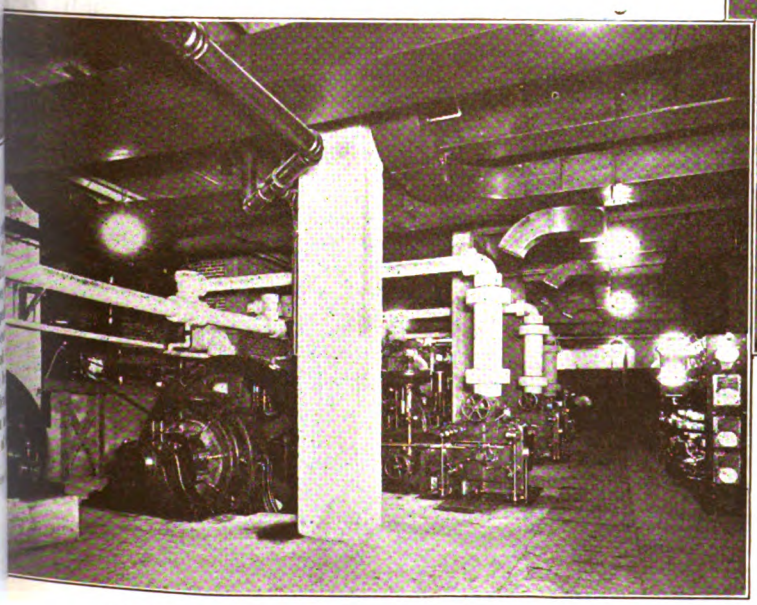
Terry Steam Turbine Co., Hartford, Conn.

ith power at a cost far below at of its own power plant; ough the latter was, a few ort years ago, one of the most ficient and up-to-date power stallations extant. So, in line ith the Ford policy, the less ficient power plant is to be rapped. In this particular se, of course, it is only beuse of the wonderful linking processes and utilizing of -products, that the saving power costs becomes so ormous.

There always will be waste, every line of human endeav-. Not even the most enthusstic engineer would claim at we can ever eliminate all aste.

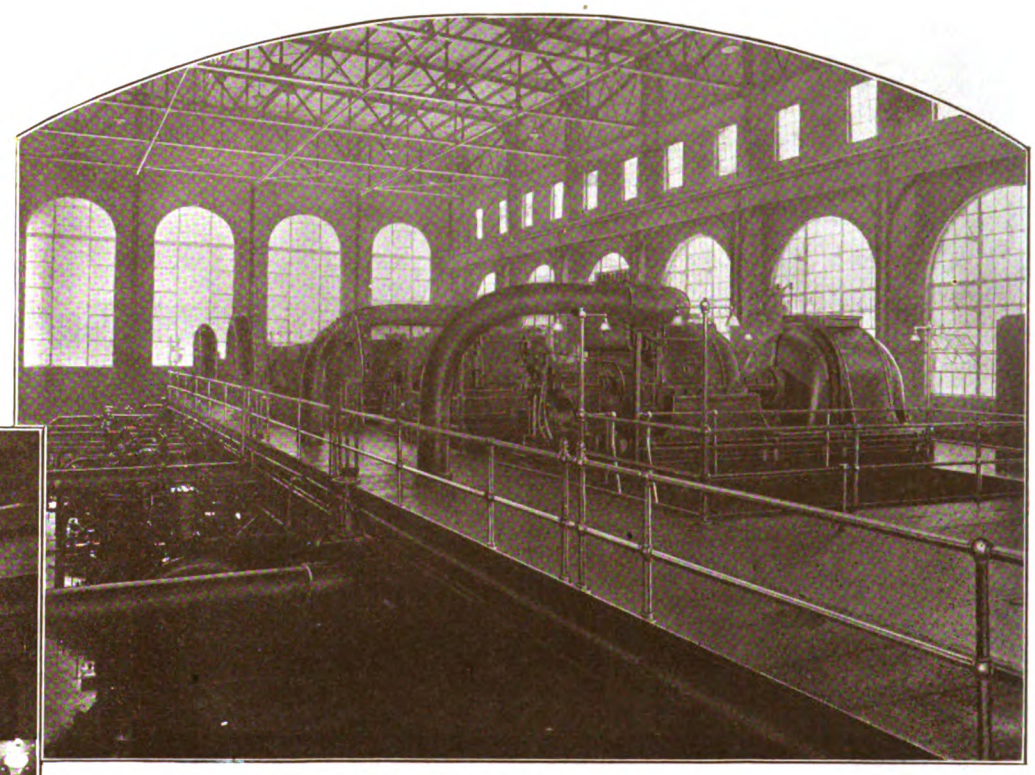
But the item of preventable aste—the losses due to ignorce, to stubbornness, to plain ental laziness—this is the ing we, in industry, must atck. As we come to see more d more clearly the inter-relation, not only of individual plants in the same industry, but the actual inter-dependence of all the units which go to make up Industry—it becomes plain that the wasteful power plant is not merely causing a loss to its own organization, but is a tax on all of us. The fuel and the money such a plant wastes, must be made up out of the general store. By just that much, it lessens the resources of Industry as a whole.

Excluding steam locomotives, with their extremely low load factor, we have in this country according to the best estimates about forty million horsepower capacity in prime movers installed. The load factor being close-



Underground engine rooms are usually hot and uncomfortable. Air washing and dehumidifying equipment, however, make this one cool. Note the overhead ducts through which the cool, clean air is introduced.

Atmospheric Conditioning Corp., Philadelphia, Pa.



Air conditioning plays an important part in a modern electrical power plant. Modern science and engineering skill provide a supply of clean cold air to generators, enabling them to carry safely higher loads and insuring longer life to insulation and wearing parts. Above are shown five turbo-generators in the municipal power plant of Jacksonville, Fla., supplied with cool, washed air.

Atmospheric Conditioning Corp., Philadelphia, Pa.

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ly estimated at 25%, we make use of roughly ten million horsepower hours for each working hour, or almost 23,000 million horsepower hours per year. So that the elimination of only the readily preventable wastes in our power generation would produce power enough to run several good-size factories.

The complete tie-up in coal production for more than four months of this year has brought us face to face with the entire subject of power in a new way. Whatever may be the actual merits of the dispute between coal miners and operators, it is perfectly obvious that we are not going to have "pre-war" coal prices in the near future—if ever. Nor can we find a substitute for coal, in the present state of our knowledge.

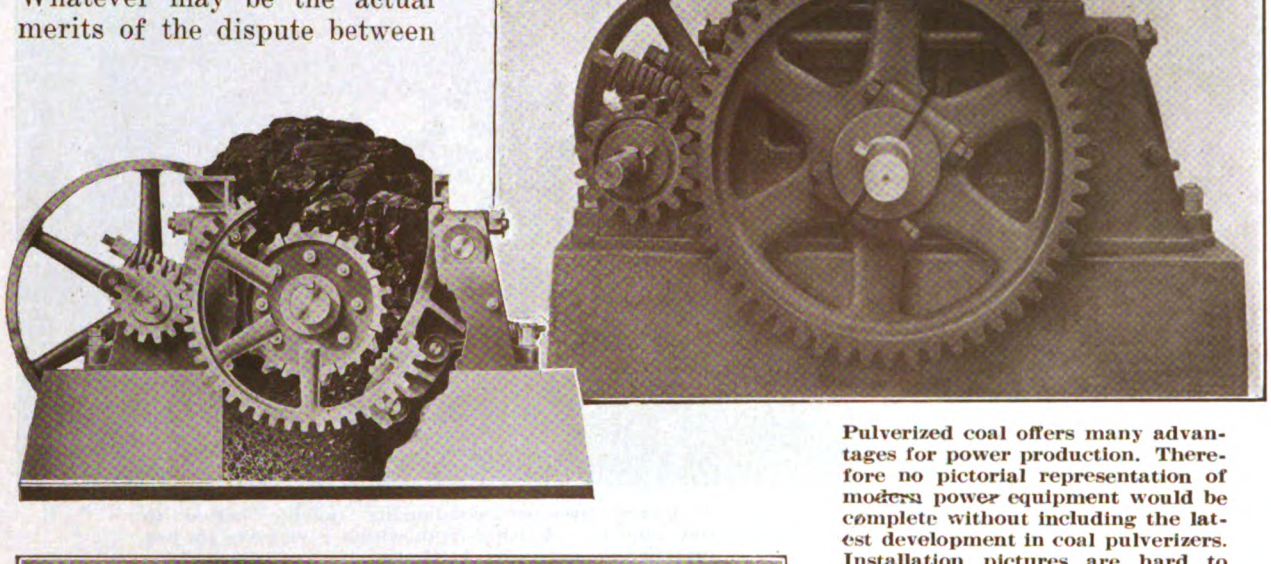
We have undeveloped water power, it is true; and one of the important tasks before us is the full development and utilization of our water-power resources. But even the most optimistic are forced to admit that there is not enough water-power available to enable us to dispense with coal.

Oil, too, is being used increasingly as a fuel for power generation. But if we were to translate our present power requirements into terms of oil production, the producers and refiners would be quite unable to meet the demand. And it must not be forgotten that geologists declare our coal resources underground to be some six thousand times our oil resources, so far as present knowledge goes.

The answer, then, to our power problem is threefold: Develop to the full our water-power; develop the use of oil as a fuel; and devote the most minute attention to getting better efficiency from coal. The first is a matter of years and of immense capital investment. The second is also a matter of time and of investment in different equipment. The third is the most important and immediate; it is something that can be done at once and without involving investment out of proportion to the immediate returns.

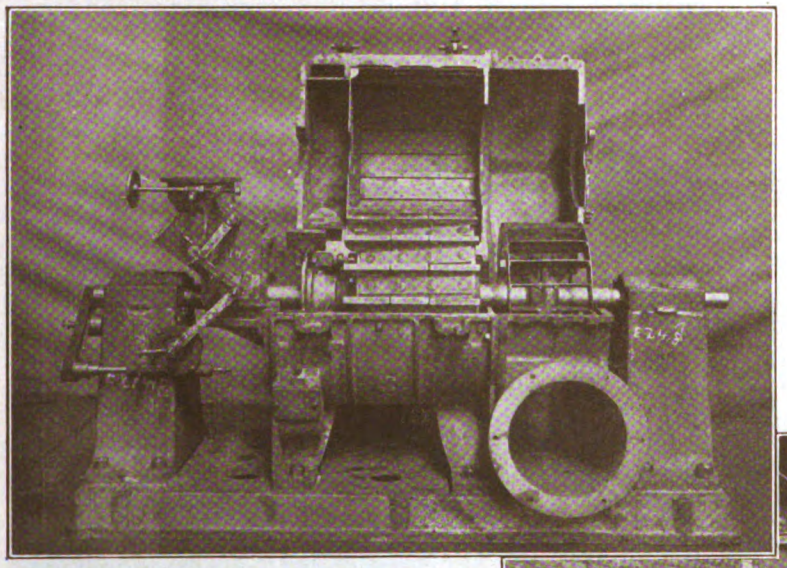
It was with this third factor in mind, that the present series of pictorial articles was planned: in order to tell what can be done, by showing what *actually is being done* in the more efficient coal burning power plants today. And, to drive the idea home, we cannot do better than to quote from an article on this subject by David Moffat Myers in *Industrial Management* for May, 1922—

"You have discovered the existence of preventable waste. Your operation is below standard for your type of plant. You know the extent of the waste of fuel and have figured in a very simple manner the number of tons of coal and dollars of money you can save in a year's operation. If it doesn't cost too much to do it you would like to save that coal and that money and reduce the cost of your manu-



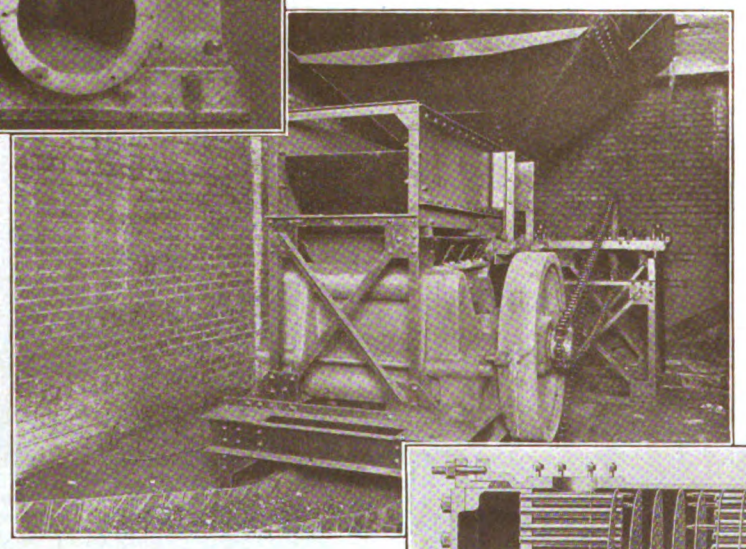
Pulverized coal offers many advantages for power production. Therefore no pictorial representation of modern power equipment would be complete without including the latest development in coal pulverizers. Installation pictures are hard to get due to the inaccessibility of the apparatus, which as a rule is installed out of the convenient range of the camera. This illustration above shows a modern coal-crushing unit and the illustrations just below it is a cross-section showing how it operates.

Pennsylvania Crusher Co., Philadelphia, Pa.



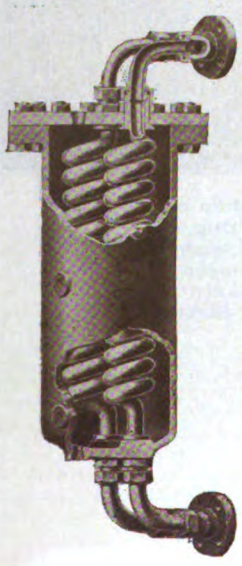
Coal pulverizers of the type shown herewith have a capacity of from 1000 to 6000 pounds per hour, and require from 20 to 80 horsepower to operate them.

Erie City Iron Works, Erie, Pa.



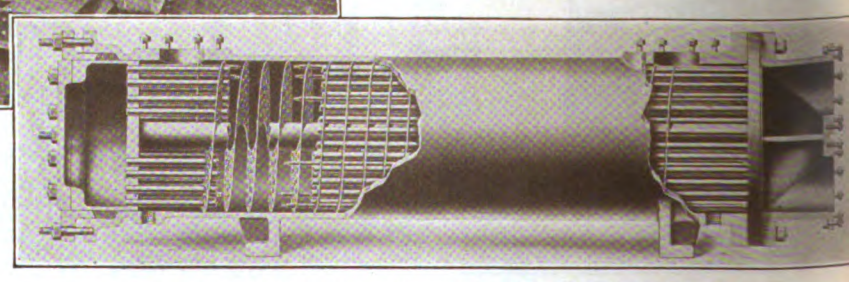
Here is a single roll crusher delivering coal to a steel apron conveyor from which point it is delivered to overhead bunkers.

Jeffrey Manufacturing Co., Columbus, Ohio.



The heavy grades of oil now in use as boiler fuel cannot be successfully burned without pre-heating. The oil heater shown in the illustration is used for this purpose, and is made up with all of its joints external to the steam space in order to prevent contamination of the high pressure steam condensation through oil leaks.

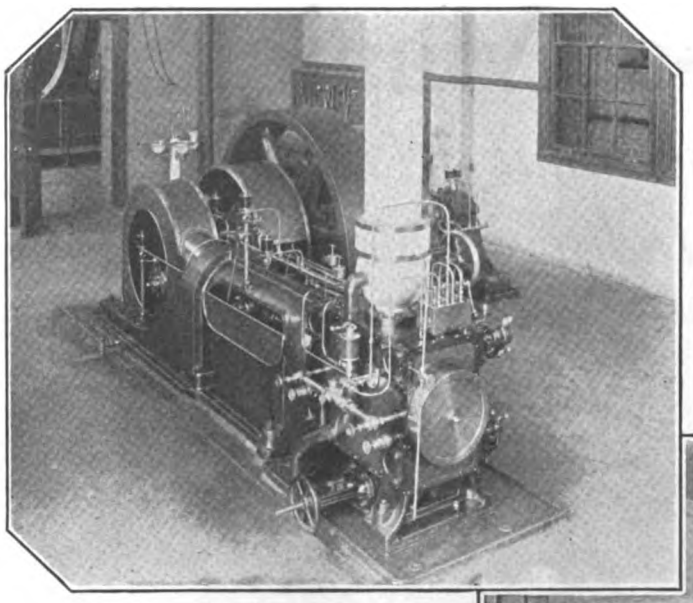
Griscom-Russell Co., 90 West St., New York.



Turbine lubricating oils and transformer oils must be continuously cooled to give proper viscosity and to permit continuous use. The unusual feature of the cooler shown in the illustration is the patented helical baffle which directs oil in its flow through the shell.

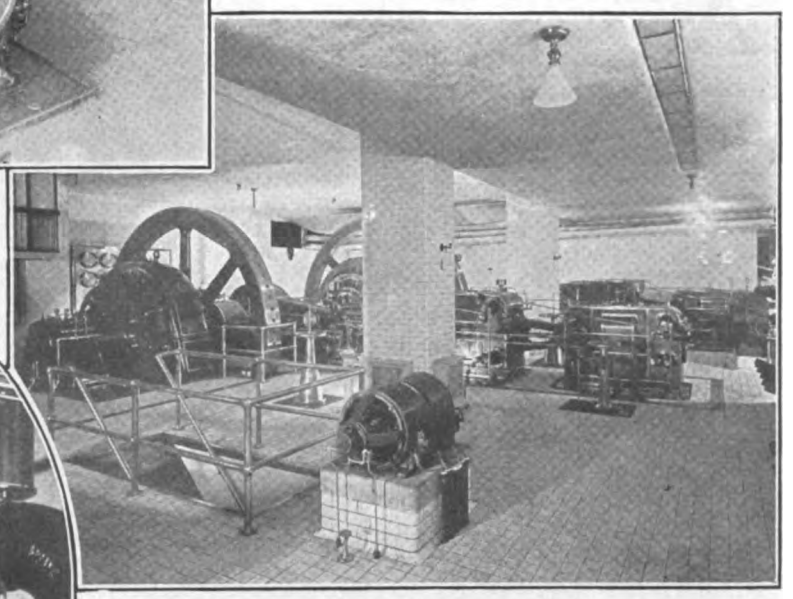
Griscom-Russell Co., 90 West St., New York.

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In the modern engine room one no longer sees the once familiar oiler and his oil can. Machinery has taken his place in the way of automatic lubrication systems, each part that requires oil being fed it under pressure through pipes. Here is a splendid illustration of this in the Aspinwall Pumping Station, Aspinwall, Pa.

S. F. Bowser & C., Inc., Fort Wayne, Ind.



In order to lubricate properly oil must be clean. Below is a view of the power plant in the Woolworth Building, New York. Note the pipe lines supplying clean, cool oil to the electric motor in the foreground.

S. F. Bowser & C., Inc., Fort Wayne, Ind.

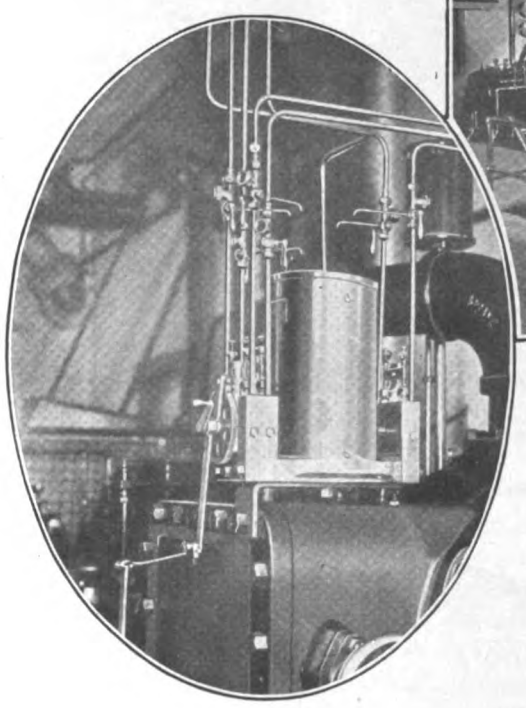
factured product by just that amount.

"Thus far, although you have learned the amount of preventable waste, you do not know the cause or causes of the losses nor how to stop them; that is unless you have got way ahead of me and I hope some of you have, for I am setting an easy pace. But this chapter is written only for those who need help.

"When you are motoring, and your car suddenly stops without warning, you know something is wrong; and if you are an old hand at the game you also know the rather long list of things that may be wrong. So you go about testing one possibility after another until you find the cause of the trouble. You will probably have in mind during your investigation the order in which things are most likely to go wrong, and by trying the most vulnerable parts first you will usually save yourself some valuable time.

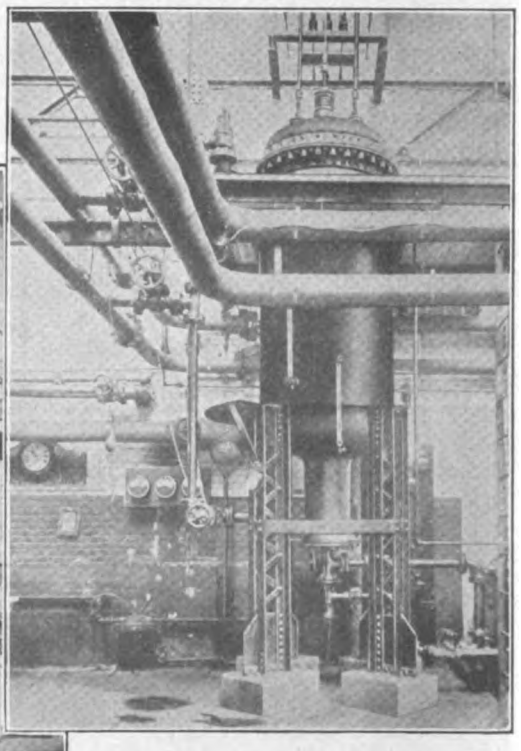
"Something, or several things, are wrong with the operation of your boiler plant. A list of the things that can go wrong can be made and these items can be set forth in the usual order of their im-

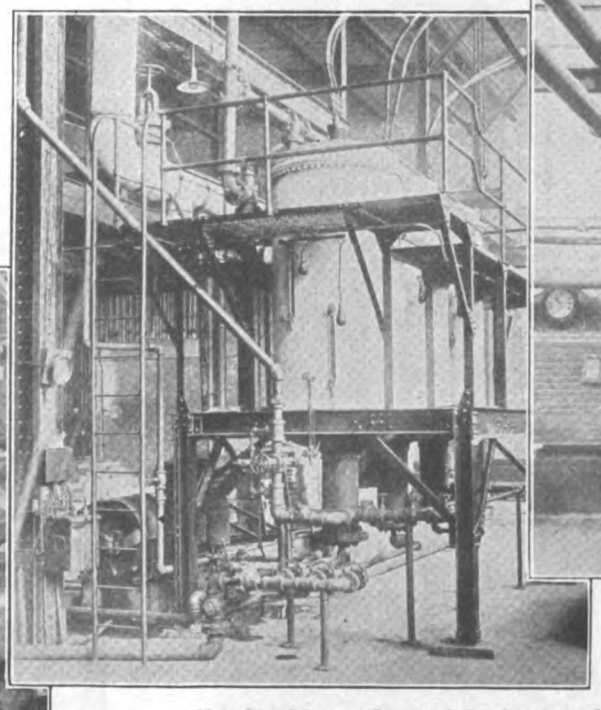
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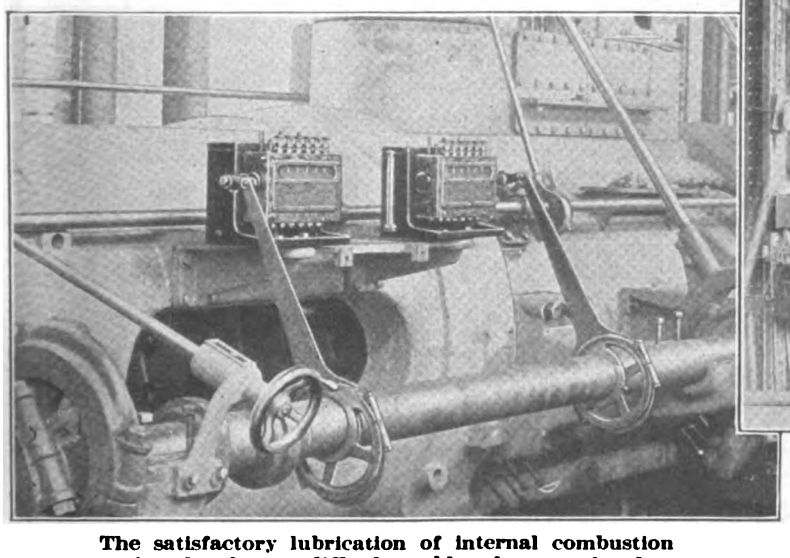


The "business end" of an oiling system is shown at the left, attached to the cylinder of steam engines. The pump is operated by a ratchet mechanism and the oil supply tank delivers clean, warm oil to the cylinder and moving parts.

Greene, Tweed & Co., 109 Duane St., New York.







The satisfactory lubrication of internal combustion engines has been a difficult problem but one that has been successfully solved by the mechanical lubricators shown above. They are driven from the lay shaft and adjusted so that the pumping plungers operate in synchronism with the engine pistons, the oil being delivered directly on to the pistons at the end of each stroke.

S. F. Bowser & C., Inc., Fort Wayne, Ind.

Closely akin to the coal-fired steam boiler but more specialized in its purpose is the electric steam generator, the most important application of which is in industries within the range of hydro-electric power plants where use may be made of surplus energy that would be otherwise wasted. These electric steam generators generate steam at any specified pressure by means of high tension alternating current, led directly through electrodes of special design into the water to be evaporated. The amount of steam generated pressure, and the amount of electric power used are governed by the height of water in the vertical tanks.

Electric Furnace Construction Co., Philadelphia, Pa.

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Sand---a Magic Substance

The Many Uses that Make a Well Known Material Indispensable to Industry

By Robert H. Moulton

A sand blast, as nearly everyone knows, consists of a box, a tube and a good head of compressed steam. We have seen how easily glass, stone, metal and other hard substances may be cut, ground, or polished when the gritty particles are directed against it. It is not generally known, however, that if the same stinging jet is directed against soft rubber or the human skin it will make no impression whatever. But if by any chance the particles strike a finger nail the nail is gouged away in a flash. That is one of the curious features of the sand blast, an invention now more than half a century old, but for which new and important uses are being discovered every year. The explanation is that rubber and the tender skin offer practically no resistance to the flying particles of sand compared with other hard substances.

But valuable as sand is as a borer and grinder, the other uses to which it is being put today are almost without number. It is used in casting aluminum and other metals; in the manufacture of articles ranging from glass to dynamite, and is indispensable in the filtration of water and the distilling of whiskey.

All sand is from rock, either tough quartz or soft limestone, broken down and scattered, each tiny particle having within itself the substantial qualities of the original rock.

The expression "cheap as dirt" may be literally applied to sand, for the price ranges from only a few cents to a dollar a ton. Yet so enormous is the quantity used that Government statistics give $30,000,000 as a conservatie estimate of the amount annually spent on this item in the building industries alone. It is impossible, of course, to check up the amount used by farmers, small builders and others, which in all probability would add several million dollars more to the total.

The futility of trying to build one's home *in* the sand has been demonstrated throughout the ages; but building it *of* sand is one of the most substantial methods ever employed. Sand-stone, sand-



Among the lonely sand dunes on the shore of Lake Michigan.

Below—a large sand pit in Illinois: steam shovel working in the distance.





A steam shovel tearing out sand and gravel in great mouthfuls. A scene down in the sand pit.



Belt conveyor whirling mixed sand and gravel through a hopper to the belt conveyor which hurries the material to the separating mill.

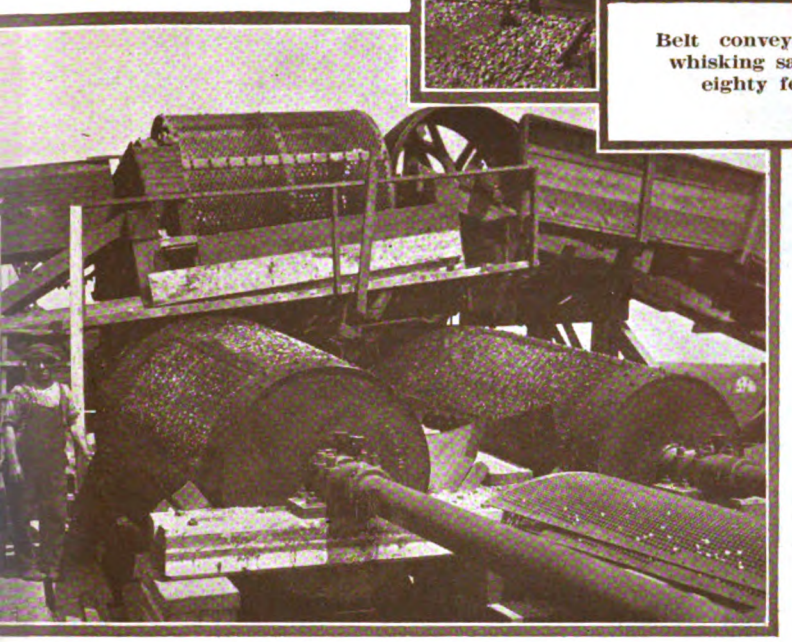
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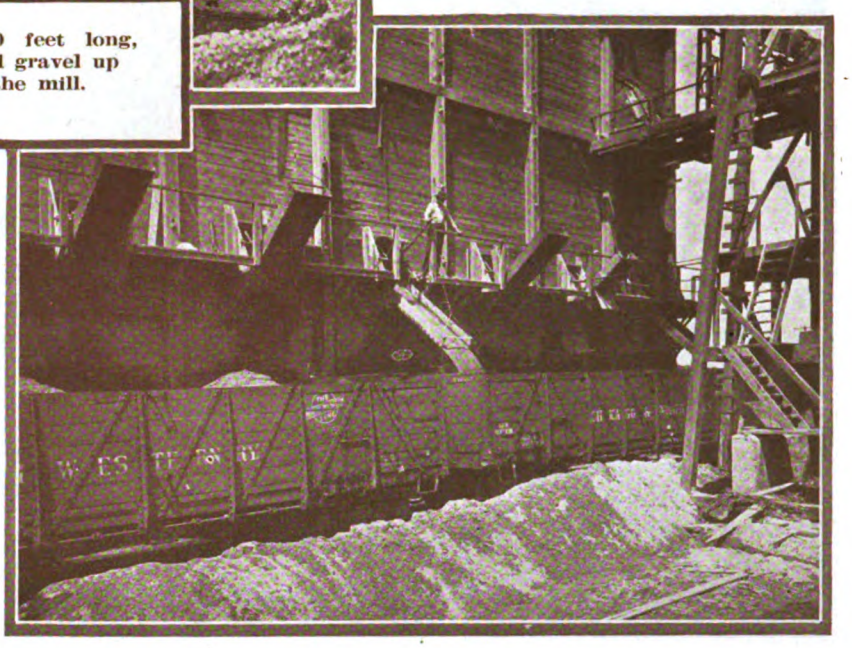
Below—Screens at the top of the mill separating the sand from the gravel. The screens are constantly revolving and streams of water inside clear the sand of all dirt.



Below—freight cars taking on a cargo of sand which shoots the chutes from the separating mill.

Belt conveyor—350 feet long, whisking sand and gravel up eighty feet to the mill.





e brick as a building ma- water being poured in as re- baking cylinder where they are rigidity and imperviousness to
al was first used by the Ger- quired. The entire composition subject to steam and chemicals frost and moisture and heat,
ns about fifty years ago. In is then stored in a hopper un- and after emerging from this when properly set, easily en-
s country the value of this til the process of hydrating, or double process of baking and titles it to this position. The
covery has only recently slacking, the lime is complete, drying are ready for the mar- best admixture is obtained
n appreciated. the time required for this being ket. A sharp silica sand, de- from calcareous sands, or those
'here are two or three well- from twelve to twenty-four rived from quartz or flint, is derived from lime-stone. While
wn systems of manufactur- hours. The mixture is then used in making the blocks, and calcareous sand, being soft, is
it. The one which has met ready for the presses, which mineral oxide is the chemical for general purposes inferior to
h the greatest favor consists are ponderous affairs, capable employed to produce various the siliceous sand obtained
utting coarse and fine sand of exerting a tremendous pres- shades of pink and yellow. from quartz and flint, it makes
arately through a drier and sure. In a second and a half The real foundation of the superior mortar and concrete.
a measuring machine, and these presses ram and crush building industries, however, is This is due to the porous na-
mixing them together. To the particles of sand into a concrete, which because of its ture of the softer sands, the
mixture is added six parts solid mass. The bricks thus plastic characteristics together mortar not binding the grains
ime to ninety-four of sand, formed are then shoved into a with its remarkable strength,

(Continued on Page 49)



One of its most indispensable uses—sand in Concrete.

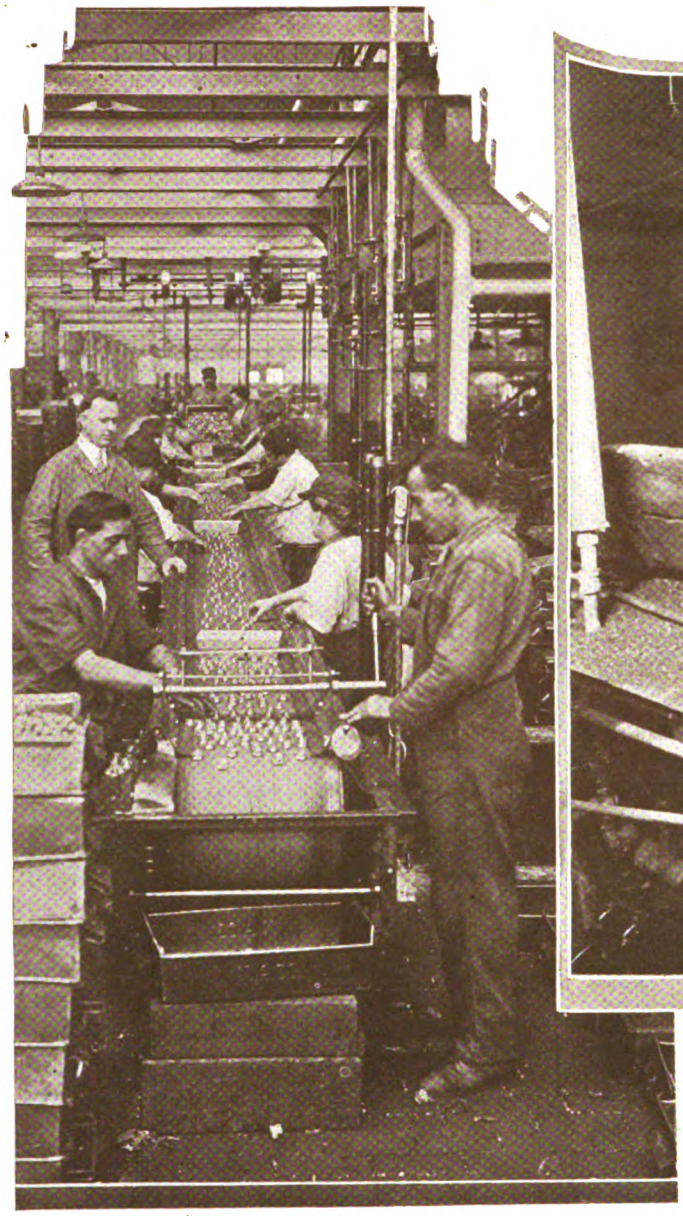


Screening sand by hand—a method used "on the job."

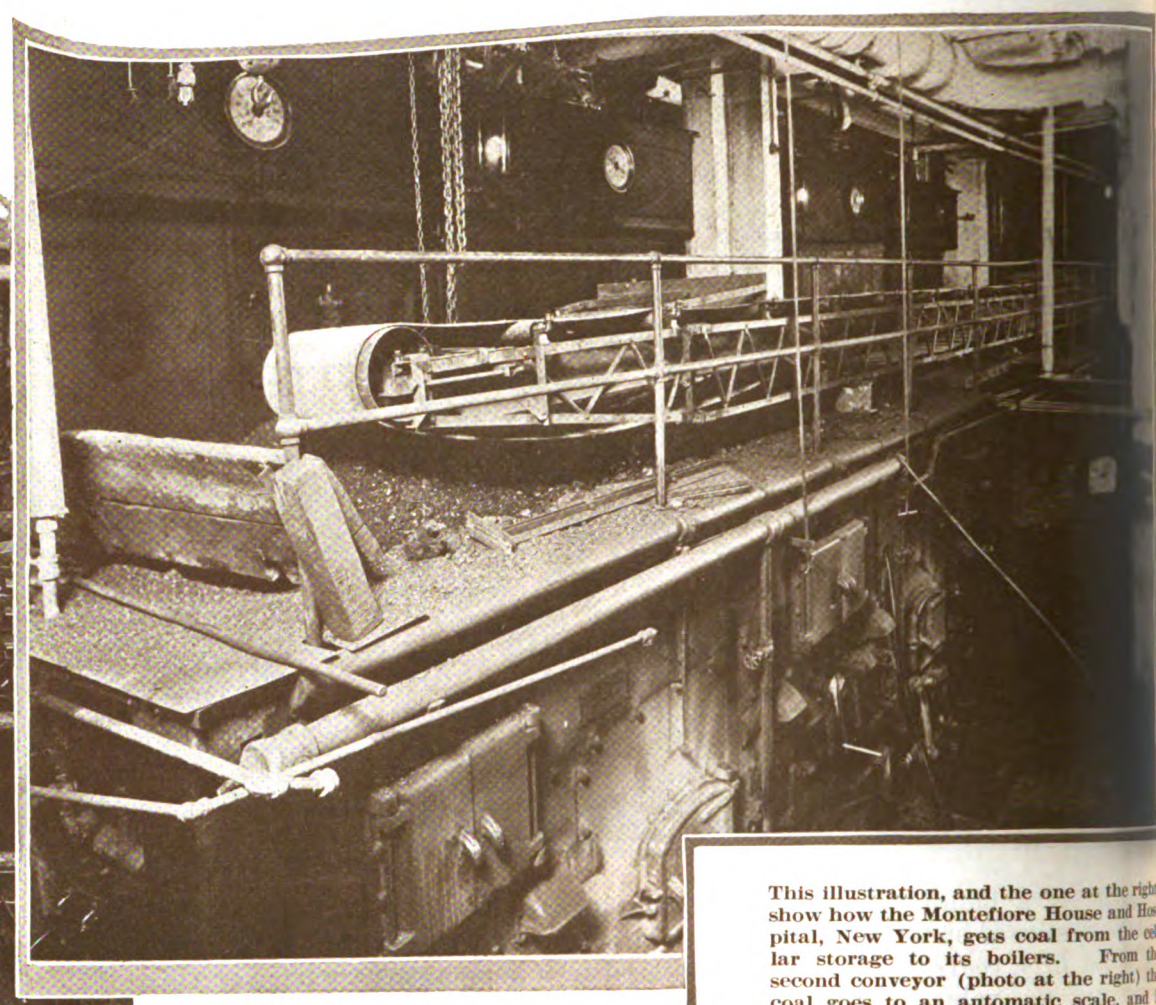
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Speeding Production with

Some Dollar-Saving Ideas



Originally purchased for handling coal, this conveyor at the National Acme Co. was converted into a moving inspection table—and worked so well that they have installed three more.

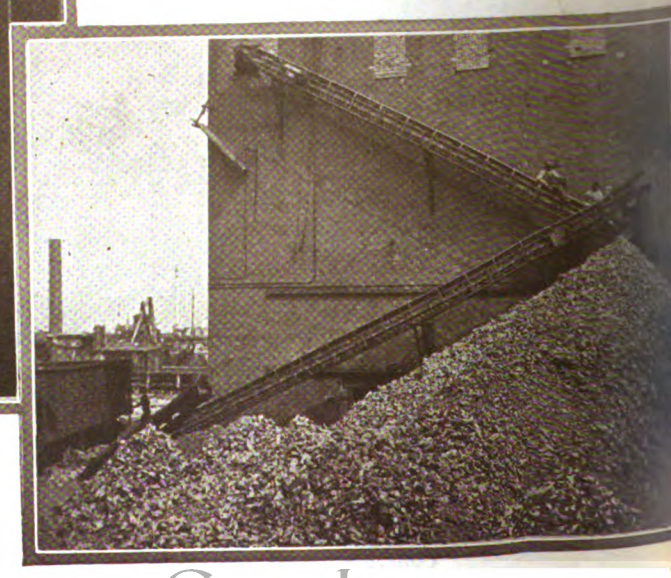


This illustration, and the one at the right show how the Montefiore House and Hospital, New York, gets coal from the cellar storage to its boilers. From the second conveyor (photo at the right) the coal goes to an automatic scale, and



One of the thirty-thousand-dollar belts in the marine gallery of the Pennsylvania R.R. grain elevator at Baltimore. These conveyors are a part of the most modern seaport elevators in the world, and have helped to handle the rapidly increasing traffic through the port of Baltimore.

Below—A conveyor installation for handling coke, rigged with chutes so that the coke is handled without being dropped more than 3 ft. This, to avoid breakage.



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Mechanical Conveyors

for the Plant Manager



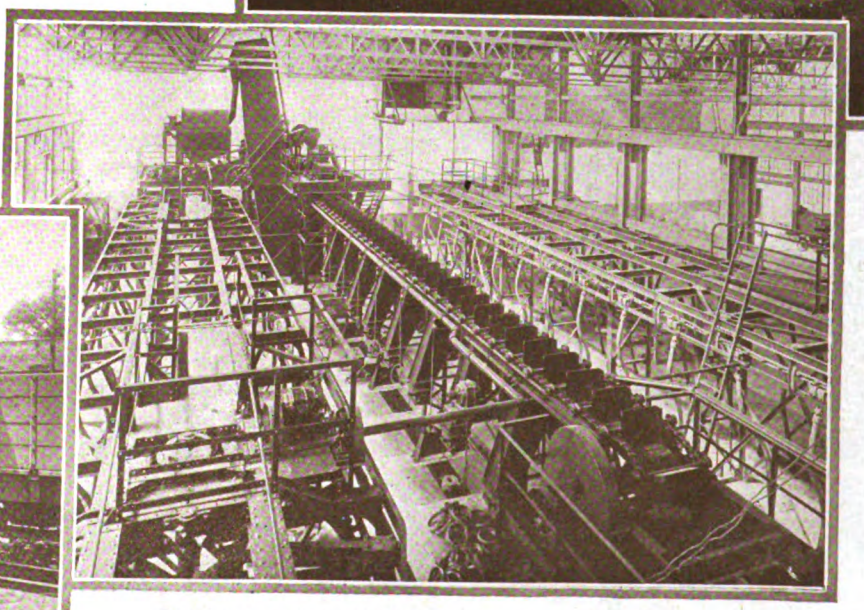
lumped from there onto the third con-
veyor (shown in left-hand illustration),
where it is scraped off by lateral scrapers
above each stoker as needed.. This in-
stallation eliminated the labor of 7 men



The two illustrations below show how the Detroit Vapor Stove Co. keep their production on the move; assembly, enameling, drying, and crating all being done on conveyors.



At the right—a steady procession of stoves coming "down the line" at the Detroit Vapor Stove Co., where both the necessary space and the number of men required for assembly have been cut 50%.



In the foundry of the Kelsey Wheel Co., the General Superintendent asserts that these conveyors have saved ninety per cent of the floor space, doubled their production, and relieved the men of all heavy lifting and bending over the work.



The man in this illustration merely scoops the material to the end of the conveyor, instead of having to lift it. As a result, he does just four times as much work, with less effort, in a given time.

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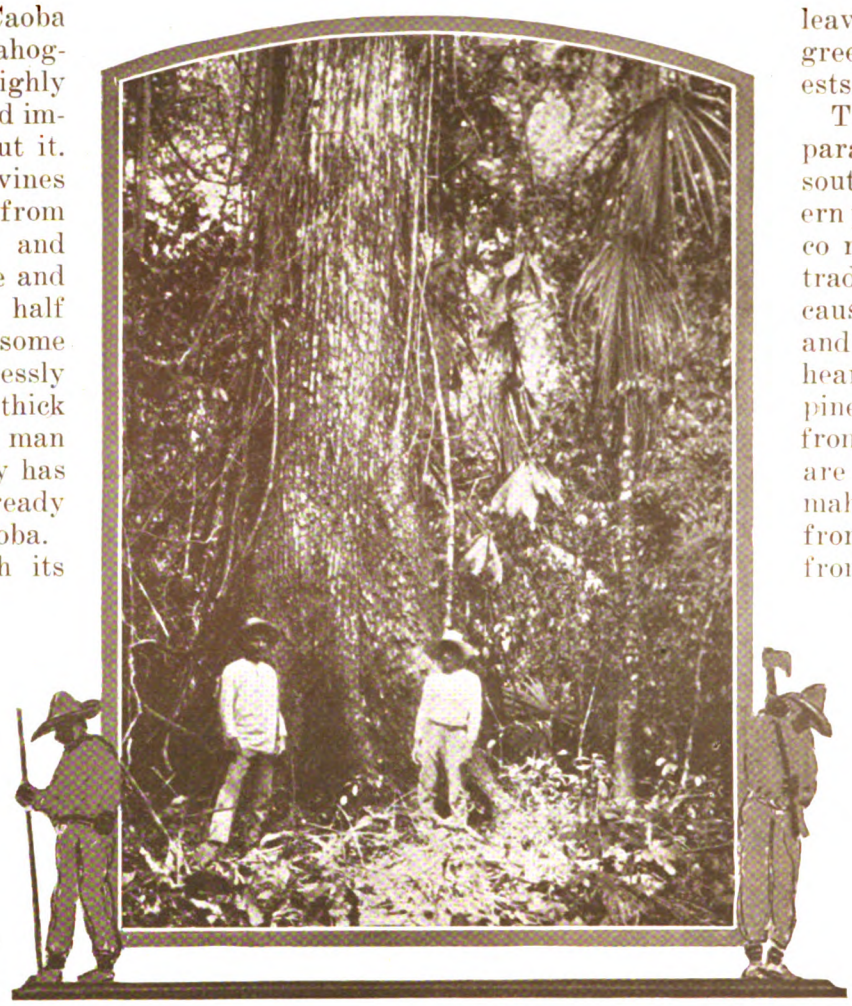
Mahogany--King of the Jungle

Picturesque, but Wasteful Methods that are Responsible for the Dwindling Supply of this Rare Wood

By H. F. Lee

CAOBA lives in the jungle. Caoba is the Spanish name for mahogany, one of the most highly prized of all fine woods. Lush and impenetrable jungle life is all about it. Palms, rubber, giant ferns, great vines—hanging like enormous ropes from tops of towering trees,—here and there the flash of an orchid, here and there powerful parasitic vines, half creeper—half tree, coiled about some respectable jungle tree, relentlessly crushing its life out! And all so thick—so unbelievably dense, that no man can pass through it until the way has been chopped out with the ever-ready *machete*. This is the home of Caoba.

Mahogany seldom grows with its kind. The single trees will be found here and there at infrequent intervals through the jungle but seldom is there a clump or grove. The tree itself is the king of the tropical jungle. Frequently it is more than one hundred feet in height and many times from 40 to 60 feet to the *horqueta*, or branching of the first limbs, the small shiny leaves standing out above the black, green foliage of the surrounding forests.



Caoba, Tabasco or "true" mahogany, at home in the jungle of Campeche, Southern Mexico. Often many hours work by the machete-men was necessary, to clear away the tangled growth and admit light for taking these photographs.

True mahogany is found in a comparatively small district covering the southern part of Mexico and the northern part of Central America. "Tabasco mahogany," as it is known to the trade, commands the highest price because of quality, size, beautiful figure, and desirable working qualities. One hears of African mahogany, Philippine mahogany and "mahogany" from other parts of the globe, but these are only distant relatives of the true mahogany and are just as different from the genuine *caoba* as you may be from your second cousin. Eucalyptus is another member of the family and is frequently spoken of as Australian mahogany.

Beautifully figured and valuable woods abound in the tropical jungle but most of them are too close-grained and hard to be worked with ordinary tools and only two or three of these rare woods can be floated out from their home place in the forest to tidewater, ships and sawmills. Mahogany has the

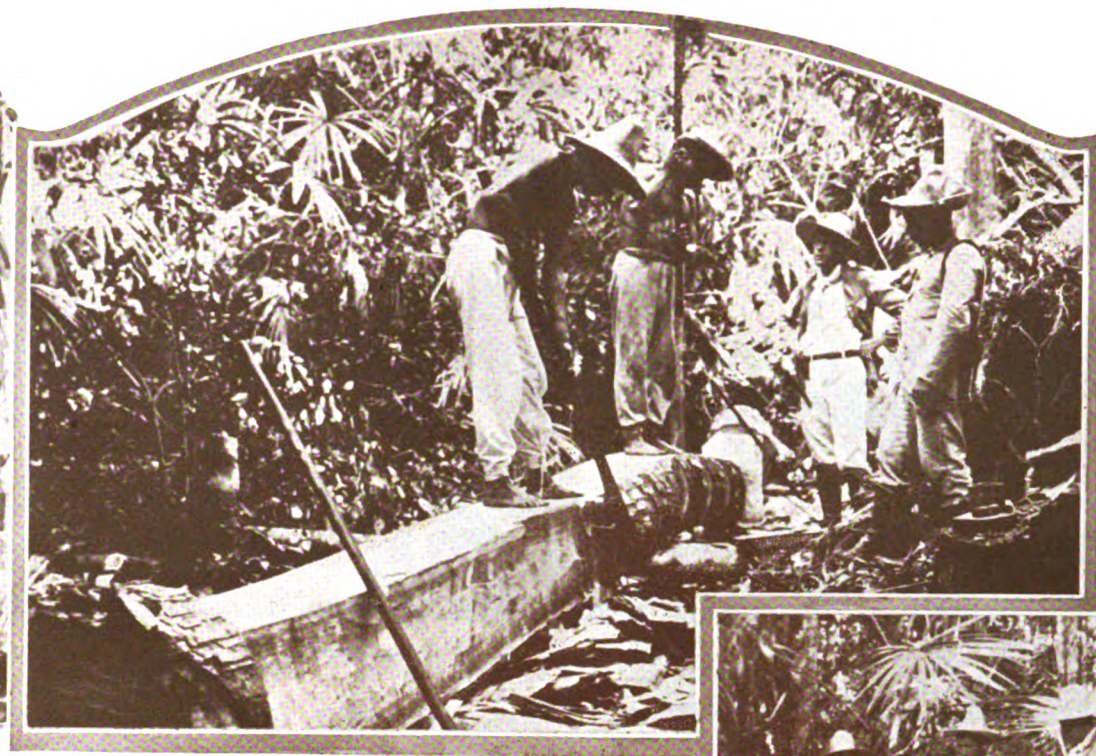
Great mahogany logs as they have been cut in the jungle of Campeche. Photo shows size of these cuts of precious hardwood.



Because of the steel-hard roots, which cannot be cut by the primitive tools used, a scaffold is built some 8 to 12 feet high, from which the cutting is done. Much valuable timber is wasted, as the mahognay stump is noted for its fine figuring.



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When the workmen have felled the mahogany tree they at once "square" the log so that it has the same thickness throughout its length. This is another highly wasteful custom and sacrifices at least 30% of the tree. The custom originated in the old days when mahogany was plentiful and cheap and when the owners of schooners preferred the square logs in trimming cargo.



After squaring the mahogany log, it is covered with the slabs that have been hewn off and then left in the woods until the dry season, by which time it has cured or dried to a point where it will float.

remarkable qualities of being light enough to float, soft enough to work easily, close-grained enough to take the wonderful finish for which it is prized, and yet, withal, beautifully ribboned or figured.

The Mahogany Spy

The mahogany prospector or "spy" goes into the jungle armed with field glasses, climbers, rope and accompanied by a "cuadrilla" of *mozos* as helpers. Once in the mahogany country he selects the tallest tree to be found, climbs up into the topmost branches and then, with his glass, locates the *cæoba*

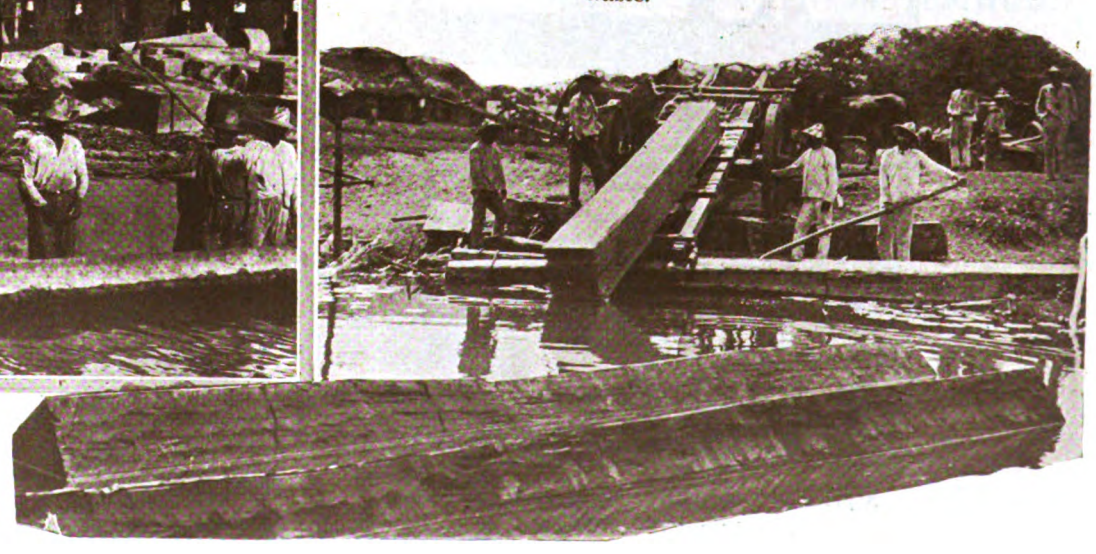


The lush, matted jungle of the south woods is divided by a small pathway overhung with dense foliage. Through these narrow alley-ways the logs are "snaked" from the forest on clumsy, two-wheeled balancing carts, called "trinquivales."



La casa grande, the owner's home, always on the bank of one of the many navigable streams, is often ten to twenty miles from where the trees are cut. It is here, in front of the hacienda, that the logs are dumped into the river.

Beginning the second stage of the long journey to market. Note the roughness of the squaring of the log in the foreground—a source of great waste.



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Running the logs through the rapids. The rafts have to be dis-assembled, and later re-assembled.





A mahognay raft in the river lashed together with huge, tough vines.



Re-hewing timbers, cutting out split or damaged ends and preparing the mahogany logs for shipment at Laguna del Carmen, Campeche.

covering the space of a circle some two miles in circumference—a wheel, of which his tree is the hub. Having determined that there is a sufficient "stand" to warrant cutting camp is pitched, the mahogany cutters are brought up and work begins.

Felling the Trees

The mahogany cutter is generally a tropical Indian armed with a very long handled mahogany axe and a *machete*. The cutting is usually done during the rainy season or, if done during the dry period, the *trozas* are allowed to remain on the ground almost a year or until the next dry season, during which time they have had opportunity to cure. The cutter will first expend much hard work in clearing away a small open space along the line where

(Continued on Page 54)



A primitive sawmill. Cutting mahogany planks for house-building.

One or two large mahogany operations are conducted by American lumbermen using modern methods, including a narrow-gauge railway to haul the logs from the forest to tidewater.



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What the Dean said to a graduating class of engineers

HE DEAN of the engineering department of a cer-ain university has had a hand in training a very rge number of eminent engineers. He has taken a ersonal interest in following them after their grad-ation; he has analyzed the reasons for their failure success.

To last year's graduating class he gave this parting dvice:

"The first thing for you to do, gentlemen," he said, "is to get the facts about the Alexander Hamilton Institute's Modern Business Course and Service."

Why should he say it?

ather an unusual recommenda-n from the Dean of a school hich sends men into life uipped, theoretically, with erything they need. Why ould the Dean give such ad-ce? What lies behind it, in s mind?

Simply this. His observations ve convinced him that ecialized training, which is so eat an asset at the beginning a man's career, can become a sitive liability as the years go Again and again you find e specialist in a subordinate sition, while at the head of e business is a man who may ow less about the particular partments than the depart-ment heads, but whose *all-round knowledge of business* fits him to direct their activities.

"I was lucky," said this engineer

Some months ago an important engineer enrolled for the Modern Business Course and Service. "I was lucky," he said. "I got in with this big organization early and have been carried along by its growth into an executive position. If the directors were filling my position today, however, they would choose a business man and give him an engineer as an assistant."

The Alexander Hamilton Institute was founded by a group of successful business men; its purpose was to carry executive training to men in commercial and industrial life.

But the Institute's service has broadened and extended far beyond the original conception of the founders. Of the scores of thousands of men enrolled, one out of every ten is a man of technical training. The need which technical men have felt for knowledge of costs, accounting, sales, merchandizing, advertising, and corporation finance, has caused them to reach out, on their own initiative, to the Institute.

And hundreds of them are in executive positions today because of the little investment which they made in this very practical training.

A book worth sending for

The facts about the Institute have been condensed for busy men into a book of 118 pages called "Forging Ahead in Business." It is a valuable book for any business library, and enough copies have been printed so that every reader of this magazine may have one. The Institute's training may be the one thing that will mean increased earning power to you. If it is not for you, it may be of inestimable service to one of your younger associates. In either event we should like to have you know what it is and does. The book will come without obligation to you immediately upon receipt of your request.

Alexander Hamilton Institute
582 Astor Place, New York City

Send me "Forging Ahead in Business" which I may keep without obligation.

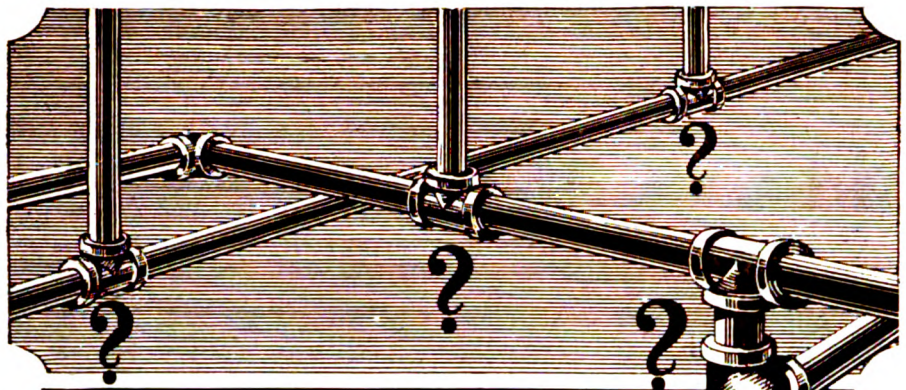
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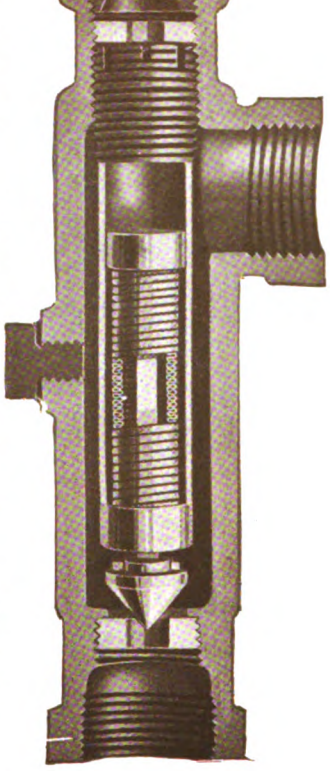


You're Wasting Coal If Your Steam Lines Are Not Thoroughly Trapped!

Because of the high cost of the "bucket" or "float" type of steam trap, many large plants are not equipped with a sufficient number of traps to take care of the condensate properly. A pretty poor policy, and one that is likely to prove very costly with bituminous coal selling up to $17.00 a ton.

To be properly trapped—and that means economically trapped—a steam system should have a trap at every point where condensate collects.

The low price of the Steam Trap Sarco enables you to buy three traps for the cost of one of the bucket or float type. In that way you can equip your lines with as many traps as are needed, at a low figure, and in that way save many tons of costly coal.



And that is not the only advantage of this trap. Built on the liquid expansion principle, it is free from the complicated mechanism found in other traps—mechanism which will get out of order and cost you money for repairs.

The Sarco closes promptly and prevents all loss of live steam. It returns condensate to the hot well while still hot.

Can be installed without supports or platform.

There are other exclusive features of a money-saving kind which recommend the Steam Trap Sarco. These are fully described in our Booklet R-13. Write today for a copy and information about our free trial offer. No obligations.

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STEAM TRAP SARCO

Getting One Hundred Cents O of the Power Dollar

(Continued from Page 17)

portance. You can then use the same kind of reasoning you apply to your car, and tackle the most important points first. This method of analysis and correction enables you to put into effect the biggest items of saving first and you can then afford to work out the smaller refinements more slowly.

"Chimney Loss is the greatest of all the losses in connection with boiler plant operation. It is technically called "Dry Gas Chimney Loss" since it represents the heat carried away from the boiler by the dry portion of the escaping gases of combustion; the "wet" portion being the superheated steam from the burning of hydrogen, from the moisture in the air supplied to the combustion and from the moisture in the coal as fired. In our cost cutting program the "wet" portion as already implied is a non-preventable loss and extremely small. So when we speak of Chimney Loss we mean the "dry" part of it and that simplifies our work.

"The chimney loss is a simple thing to comprehend. Everybody knows the heat goes up and out of the chimney, and that this heat is carried by the hot gases leaving the boiler, and that these gases have received their heat from the coal that is burned under the boiler, and hence this heat is a loss.

"Now, how to reduce this chimney loss? That too is really very simple. The amount of heat these waste gases carry away depends upon the volume or weight of the gases and the temperature to which they have been raised. Hence to reduce the loss you must reduce the quantity of gases that go up the stack, or their temperature, or both.

"To reduce the quantity of gases it is only necessary to reduce the amount of air to the economic minimum; that is to the point where there will be just enough air to give complete combustion of the fuel and no more. Any air in excess of this quantity takes heat from the fuel and carries it up the stack as needless waste, instead of allowing this heat to become absorbed by the water in the boiler. T excess air, which causes greatest single waste of in boiler operation, enters increases the weight and w of the flue gases in two w First through the grate stoker) of the furnace and ondly by leakage through boiler setting at points tween the furnace and the take.

"In many cases *as much will leak through the brick ting as will enter through grates and fuel bed.* wasteful leakage of air oc to some extent through brick work showing no cr or imperfections. It occur joints between clean-out flanges and brick work, thr doors that do not close fectly, through all bad join of brick setting to boiler h ers, shelfs and drums. S your boiler setting to l all such joinings. A good to demonstrate air leaka to cover the fire with soft to produce heavy smoke. T quickly close the uptake da er. The smoke will spurt through the leaks. Ano way: take a candle or s torch and play the flame cl ly over all suspected and suspected areas. Go on to the boiler as well as aro the four walls with your t ing. A vulnerable location infiltration is the joinin the front header of a w tube boiler with the brick w Similarly between the she a horizontal water tube b and the front wall.

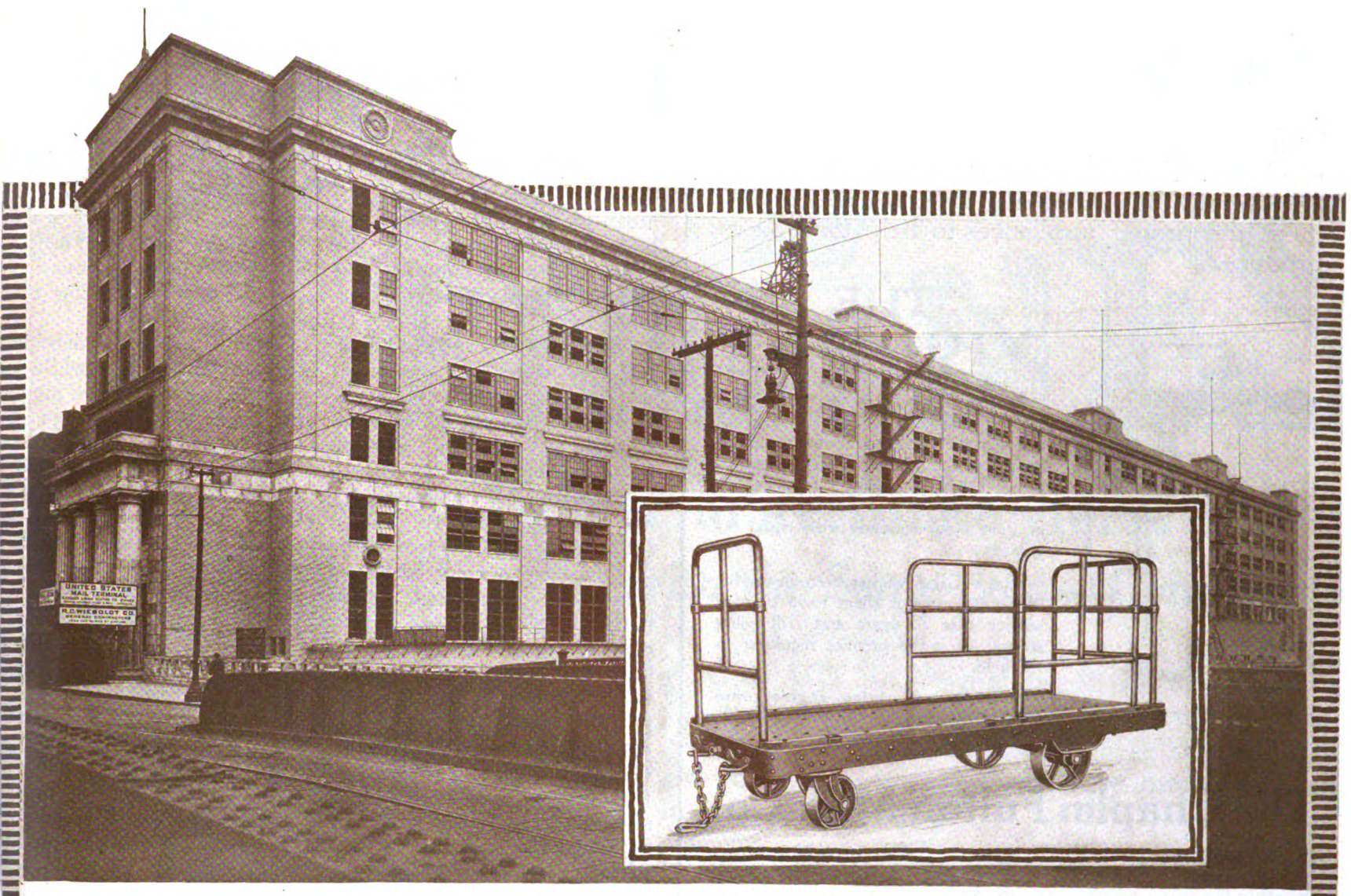
"Having located the leaks, stop them. Plug up big cracks with waste so in asbestos mortar. Use eral wool around hea Then coat the boiler thoroughly with one of several air-tight plastic c ings which can be purch at moderate cost. Over all cleaning and access d for tightness of closing pays to use the air-tight of door with gaskets clamps.

"Having done these si common-sense things you have eliminated part of waste fuel due to excess chimney loss which is often found.

"For perfect combustio

(Continued on Page 28)

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The New Chicago Railway Mail Terminal uses more than a thousand K & J Trailer Trucks

On big installations, where carrying costs must be figured to the last notch—where the work to be done is so large that the effect of even very small shortcomings of equipment would be multiplied, through day in and day out service, into huge annual wastes—on installations such as this, "K & J" Trailer Equipment has demonstrated itself to be safest.

In this great, new Chicago Mail Terminal, over eleven hundred "K & J" Trailers and Trucks are being installed to meet the initial needs of this huge modern plant—a plant of national importance, designed for the quick, efficient handling of mails in this vital center of mail transportation.

The trailers, of the type shown, are of 4000 lbs. capacity, having a 36"x84" platform. Rear wheels have individual axles.

These trailers are equipped with Hyatt Roller Bearings, with ball bearing caster swivels.

The experience developed by the "K & J" Organization, in meeting the exacting needs of such large installations through many years of truck and trailer building, is ample assurance of its unrivalled fitness for taking care of all classes of truck and trailer requirements, either large or small.

Write for Bulletin 510.

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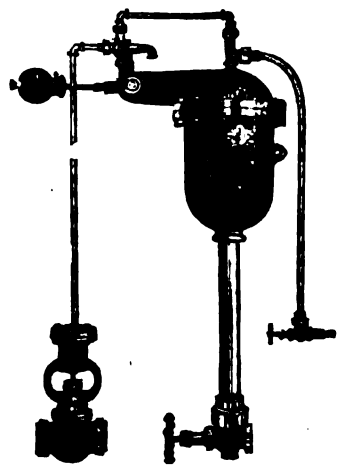
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THE VIGILANT FEED WATER REGULATOR

will help the men in obtaining maximum output at the minimum coal consumption. It keeps the water level at the proper point. It responds to peak load or light load demands with equal regularity.

The VIGILANT has been in use for 25 years—some of them have been in service over 20 years and still going strong. It is the premier regulator in the field.

Write for our Catalog. It gives some interesting facts on Boiler Feed Water Regulation.

The Chaplin Fulton Mfg. Co.

28-36 Penn Ave. **Pittsburgh, Penna.**

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"They Wear to a Stub"

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If you are interested in bringing down the costs of your sweeping expense, sign the coupon below and mail it in to-day. We will advise you about the type most suitable for your work.

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(Continued from Page 26)

chemical requirements are 11.47 lb. of air per lb. of combustible. In practice we shall often find as much as 34.87 lb. of air have been supplied, or a surplus of 203.5 percent as shown in the next column to the left. Now if the temperature of the gases leaving the boiler is 600 degrees F., the chart shows the chimney loss to be 28.5 percent of the combustible.

"If now we succeed in reducing the excess air to a point where we are supplying say 17.6 lb. of air per lb. of combustible the chimney loss with the same flue temperature will have become only 14.5 percent. We have, therefore, added (28.5 — 14.5), 14 percent to the former efficiency as based on combustible consumed. Thus if the old efficiency was 55 percent, it will now be (55 + 14), 69 percent and (a) we shall be making (14/55) = 25.4 percent more steam for the same fuel; or (b) burning (14/69) = 20.3 percent less fuel for the same amount of steam as previously.

"This is enough for the present to show the importance of reducing air supply to the correct proportion. Now we must continue with the story of how to reduce the air to the proper minimum and how to *know* when we have reached that point.

"As already stated, the surplus air enters (1) through leakage or infiltration and (2) through the grate or furnace and fuel. We have discussed the first and shown how to stop this part of the trouble. Now for the second.

"Too much air enters through the fire bed from the following causes. (1) Holes or thin spots in the bed of fuel on the grate. The cure for this is to keep these holes or thin spots covered with fuel. Firing large lumps of coal with slack or fines tends to produce an uneven fire with holes. Therefore break up the large lumps before firing. For stokers, all coal should pass through 3-inch mesh. Carrying too thin a fire will permit the quick and easy formation of these undesirable holes and spots. Therefore, carry it a little thicker and watch it carefully. Six to eight inches thick for a soft coal fire is a good general rule which has, however, several exceptions. One instance, as the fire accumulates ash it is necessary to build up its thickness gradually until it can be reduced again after cleaning. A good design of shaking grate helps to keep the ash cut out from the bottom of the fire so that it need not be built up to so great a thickness. Stokers both hand operated and automatic, add modifications to the general rule according to design.

"(2) Clinkers which have formed in the fire while cutting off a part of the air supply tend to form holes near their edges and thus admit streams of excess air. The cure is to keep the fires clean. Often a change of coal will help, a coal having less ash and ash with a higher fusing point. It always pays to take the trouble of making a survey of the coal market. Frequently a better coal can be bought for the same money. Clinkers are formed by the bad practice of stirring the fire up from the bottom. This brings the ash up on top where the high temperature causes fusing and clinkering. Sometimes a little exhaust steam admitted below the fire will reduce clinker formation.

"(3) Too strong a draft. Reduce the force of draft by partly closing the uptake damper. This applies to either "forced draft" or natural draft. In the case of mechanical or forced draft regulate the blower speed to give the pressure required to furnish the necessary air; then adjust the uptake damper, throttling the natural draft down to a point which will produce a slight vacuum in the furnace or atmospheric pressure if it does not cause too rapid burning out of furnace linings.

"These three causes and cures of excess air through the grate and fuel bed all relate to good firing and good control of combustion. A good fireman is worth his weight in coal about three times an hour as compared with a poor fireman. I have plenty of figures to prove this. But the good fireman needs help and encouragement from headquarters. Let me now add the following warning. Heavy firing at long intervals means insufficient air immediately after firing. Then before the next firing the fuel bed has

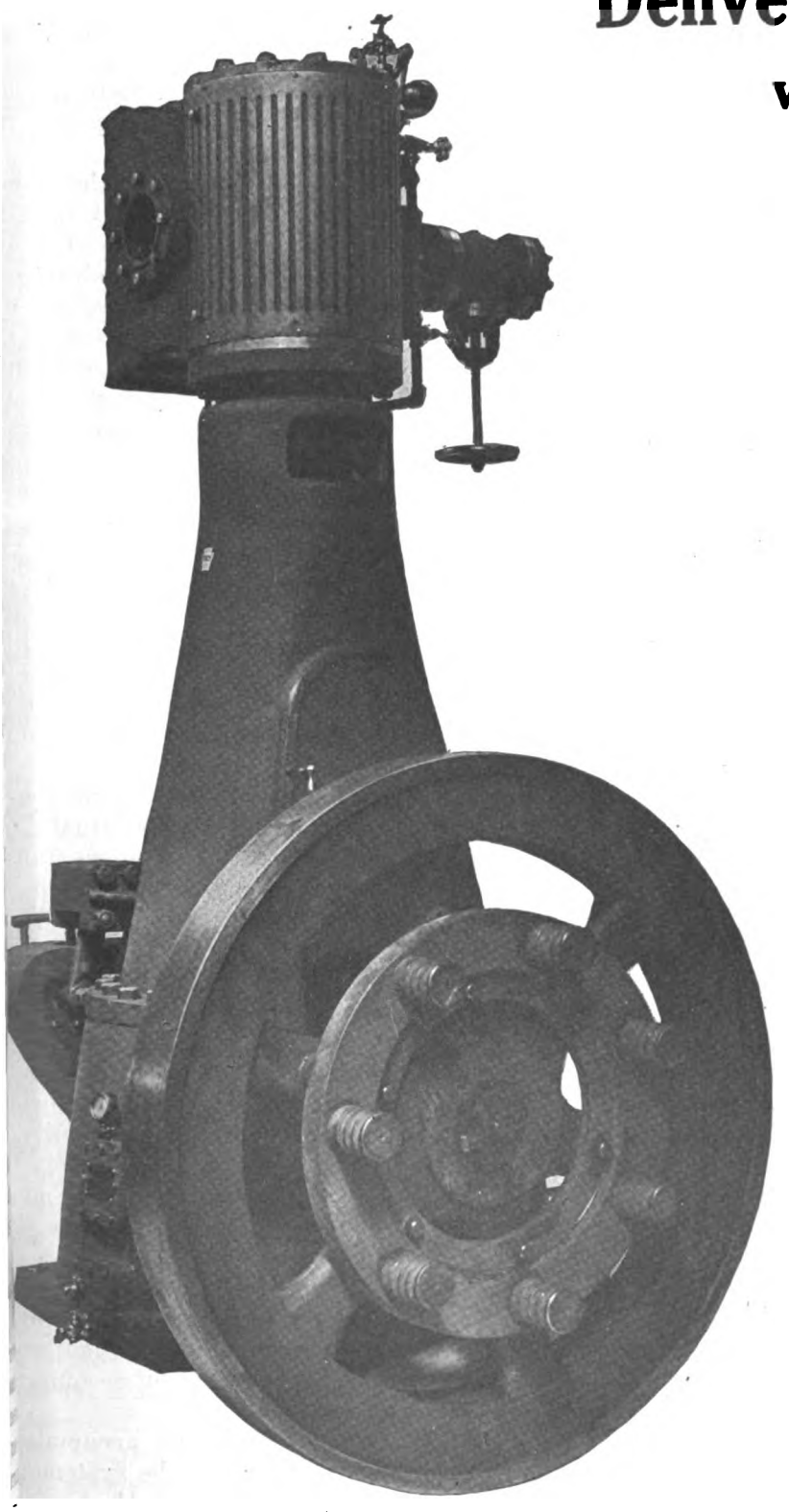
(Continued on Page 30)

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These features assure long life and **greater Brake Horse-Power with the Same Steam Consumption.**

It will pay you to have a copy of our booklet in your files. It describes the various types of TROY ENGINES which are built in sizes from 2 to 200 B. H. P.

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Rectigraph emulsions are coated upon a high grade 100% rag stock, producing excellent results with a durable base. Rectigraph paper is a contrasty bromide paper with excellent orthocromatic qualities, and will reproduce colors perfectly. All the speed consistent with good quality.

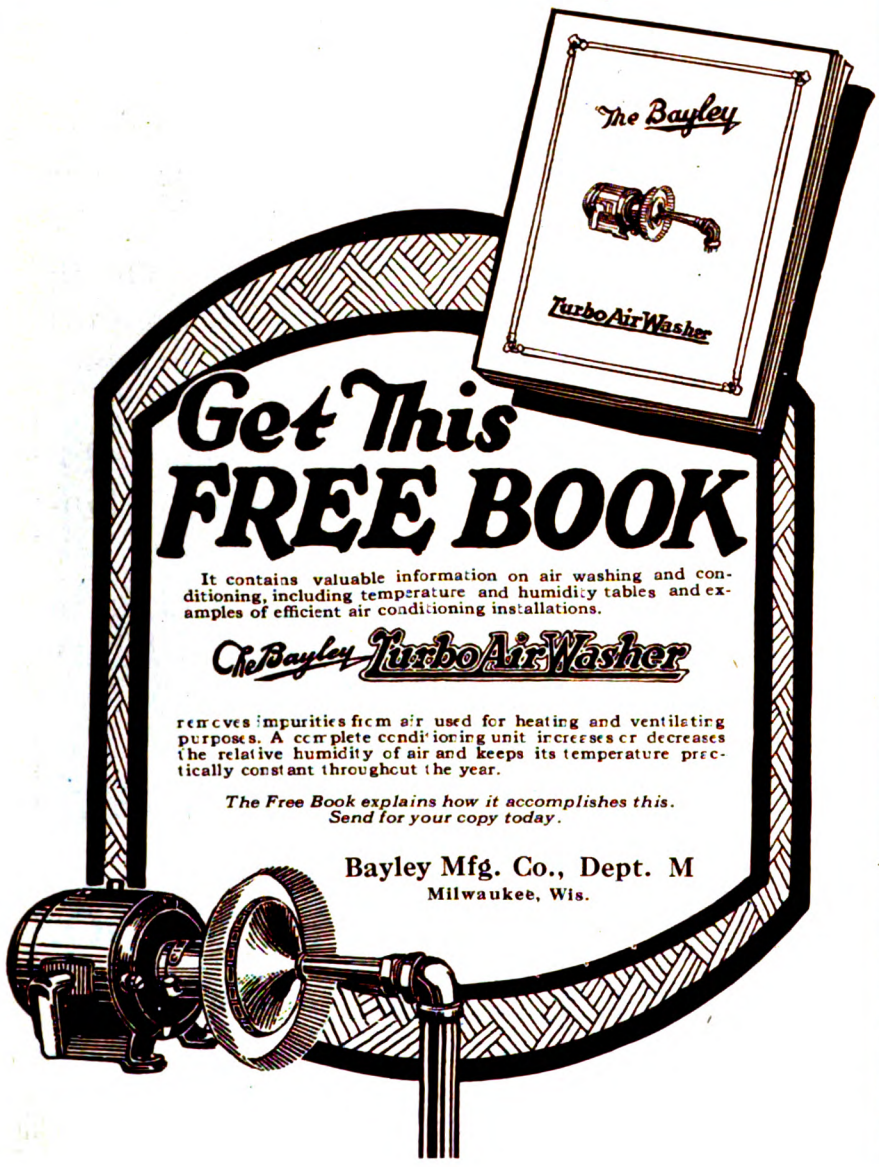
The RECTIGRAPH COMPANY has always regarded acceptance of an order as a pledge that it would be filled at the earliest possible date. The output of our plant belongs to our customers with orders on our books. This policy compelled us, during the past few years, to decline much desirable business which would have been highly appreciated, but this could not be considered without prejudice to previous connections. Improved facilities in our new plant enable us to increase production and quality and to decrease manufacturing costs. *Our Customers will benefit.*

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Rectigraph Company

(An Independent Corporation)

ROCHESTER, N. Y.



(Continued from Page 28)

come thin and full of "spots" and holes which mean another and usually greater waste from too much air. So the poor fire alternates all day long from a condition of feast to a condition of famine, which is unhealthy for the coal pile and the pocket book. The automatic stoker is designed to overcome this difficulty and sometimes does it almost completely. Hence good hand firing must at least approximate this ideal, which means frequent firing in small amounts.

"Now we have seen how to go about the job of cutting down surplus air and how great an effect this may have in reducing the largest waste in connection with boiler operation. By this time, however, someone in the audience will have asked the question. "Isn't it possible to go too far in reducing the air supply?" and I shall have answered, "Yes, sir, it is." "Then how do you know when you have reached the economic limit?" Then like the professor I say, "I am so glad you asked that question." For its answer is the next logical step in our program. And the answer is this. Reduce the air supply down to that point beyond which the combustion becomes incomplete. As the air supplied per pound of combustible is reduced the CO_2 found in the products of combustion is correspondingly increased. In boiler practice we can not very closely approximate the bare chemical air supply. We must give additional air in order to insure contact between the oxygen molecules and those of the fuel gases. The minimum amount of surplus air we must thus furnish depends upon how nearly furnace design and operation approach perfection. Prof. Bone with his surface combustion did approach this perfection closely with a correspondingly high boiler and furnace efficiency.

"Fifteen percent CO_2 is a good mark to shoot at. You may have to stop cutting down air supply before you reach that point or you may with certain equipment and fuels somewhat exceed this high mark. In any event go as high in CO_2 as you can without producing unburned gases. The best indication of unburned gases is the presence of CO as detected by an "Orsat," with which you may also determine th CO_2. I shall not describe th Orsat Gas Analyser, nor ho to use it. You can find out b reading some good literatu on the subject, or by consul ing your technical men. Th point here is that you ought know how useful a $25 Ors is for checking up the combu tion and regulating the firi for proper air supply.

"There may be other u burned gases besides CO i the flue gas. There might b unconsumed hydrocarbons an hydrogen; the former parti ularly in the case of very wea draft, heavy firing of soft co and insufficient combusti space when these conditio will probably be accompani by heavy smoke. These oth gases are difficult of determin tion, which is unnecessary i our present program.

"The point to be absorbe here is simply the fact that very small amount of CO i the products of combusti neutralizes the good effect additional percentages of CO Hence as before advised, ru your air supply down and yo CO_2 up until you begin to g traces of CO and then sto Further improvements mu then come from better fu nace design.

"The remaining factor Chimney Loss is the tempe ature of the flue gases. Th should be kept as low as po sible. With this object in vie the following suggestio should be of service:

"1. Be sure there is no sho circuiting of the products combustion. The gases mu traverse the complete path the heating surface. Wi horizontal tubular boilers t fire gases sometimes find the way directly to the uptake smoke breeching through hol in defective front arches a through a burned extensi front. Inspect this locality

"In a water tube boiler, sure the baffles are all in go repair; otherwise you are t loser.

"The boiler heating surfa must be kept clean inside a out. Scale and sludge a mud occur inside on account impure water.

"Soot and dust accumula outside and must be systema cally removed. Mechani soot blowers should be used every case where they can successfully applied. And member, it's no use blowi

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ubes upon which the soot has become caked. They must be thoroughly cleaned first. You must start with clean tubes. If you will remember that *a coating of soot is equivalent to five times its thickness of asbestos* in keeping the heat out of the boiler you will certainly be encouraged in your efforts.

"Scale and sludge and deposits from impure feed water on the inside of the heating surface form the subject of a very special problem involving much technical information, so involved, that present space forbids its treatment. But you must keep your boilers free from scale because it causes burning and bagging of tubes and sheets and is an element of danger as well as of waste. If you are up against this problem my advice is, consult some competent authority.

"Another cause of high flue temperature is over rating of the boiler; that is to say, burning so much fuel that the heating surface is unable to absorb its proper part of the heat developed. The average plant, however, does not have this difficulty. On the contrary, the average plant operates too many boilers at too low a rating for the best results. No hard and fast rule can be given. In general it pays to operate at 125 percent to 175 percent of nominal boiler rating. There are special conditions where 300 percent and even higher is justified."

* * * *

Recent developments in the burning of oil instead of coal under boilers, lead naturally to a consideration of this subject. With the present prices of coal and oil, there are cases where a change from the former to the latter fuel may prove economical.

Again, when we begin to compare the cost of coal fuel and oil fuel, for burning under boilers, the important thing is the cost per B. T. U. And from the power angle, we must go further than merely to consider oil as a fuel for steam generapower plants today. Recent tion, because the internal combustion engine provides another—and important—path from oil to power. Although neither water-power nor oil—nor both combined—can at present supplant coal as the backbone of our power program, they can, and must, supplement it.

To round out this series of articles on power, then we will take up in succeeding issues the consideration of fuel oil handling and storage, the use of oil as a fuel for steam generation, and the various types of oil engines; in each case showing, as in previous articles, what is actually being done today.

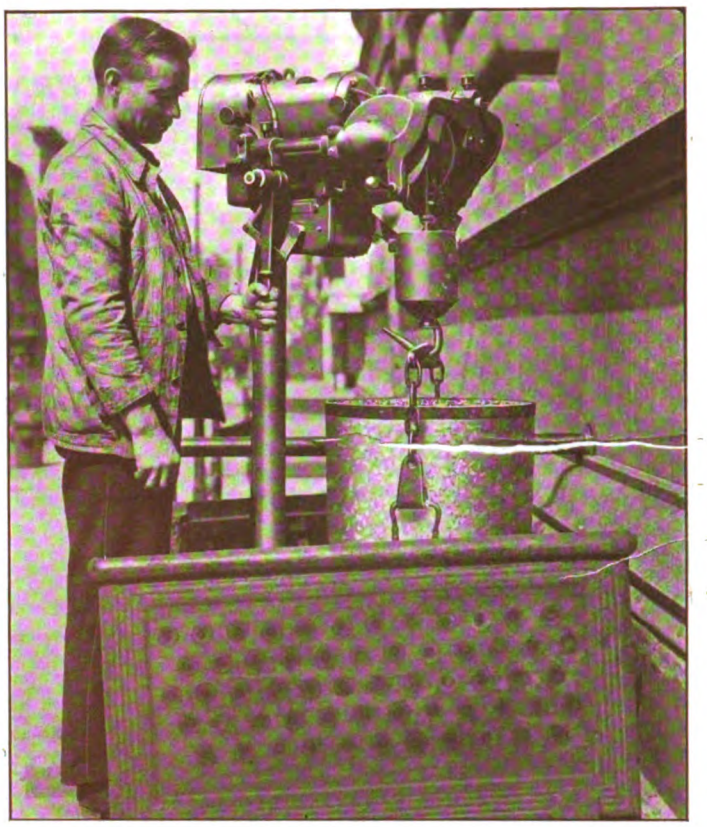
Night in the Steel District

(*Continued from Page 13*)

The name "Steel" as it is used today has a different meaning from that originally understood. About the time of our Civil War, there were wrought iron, which was almost free from carbon; steel, whose carbon content ranged from three-tenths of one percent to about two and one-fifth percent; and cast iron, whose carbon content was so large that it was too brittle to be worked at any temperature. The best class of steel was known as crucible steel, because it had been freed from slag by melting in crucibles, and was commonly referred to as "cast steel."

Since all the other varieties of iron (iron being the inclusive term, because steel and iron are different only in degree) contained a good deal of slag, "steel" became associated with purity and quality in the product. As a consequence, when the invention of the Bessemer and open-hearth processes introduced a product free from slag, although this actually was iron—rather than what was then understood by "steel" — the manufacturers claimed that it should be called by the latter name because it resembled steel in purity; even though it lacked the essential characteristic of taking a temper.

It is from the date of the invention of the processes mentioned above, that the modern story of steel begins. These, the blast furnace, and Thomas' discovery of a way to eliminate phosphorus, started steel on its amazing industrial march.



Model E Electric G&G Telescopic Hoist in use at N. Y. Telephone Co. Bldg., Brooklyn, N. Y.

85 Round Trips for One Cent Current Consumption

HERE is more evidence of the thrifty use of current by a G&G Electric Hoist. The Bell Telephone System uses 56 Hoists in its various buildings throughout the country.

At its main Brooklyn, N. Y., Building test was conducted by engineers of the Sprague Electric Works, with the following results. Can filled with ashes, weighing 150 lbs. was raised electrically and lowered by gravity 12 times. Distance of lift 16 ft. 8 in.

Can	Starting Amps.	Running Amps.	Finishing Amp.	Seconds
1	4.3	3.8	4.0	12
2	4.2	3.8	4.0	12
3	4.2	3.7	4.2	12
4	4.3	3.8	4.2	13
5	4.4	4.0	4.3	12
6	4.3	3.75	4.25	13
7	4.45	4.0	4.3	12
8	4.5	3.9	4.3	13
9	4.5	4.0	4.2	12
10	4.5	3.8	4.3	12
11	4.3	4.1	4.4	13
12	4.2	4.0	4.35	12

Average watt-secs. for average run 12,155
Number of cans raised in 1 kwh. 296
Cost of current $.0348 per kwh; Net result, 85 round trips for one cent current consumption.

If you will tell us the kind of loads you are handling, the distance of lift, and something about the working conditions, our Engineering Department will be glad to recommend the proper G&G Hoist to meet your requirements and will quote you the cost of same. It places you under no obligation to ask for this information.

GILLIS & GEOGHEGAN
556 West Broadway New York City

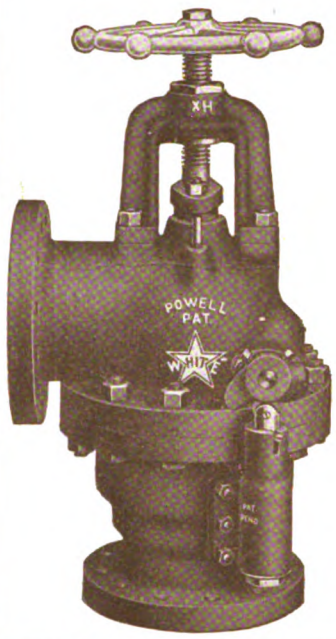
The G&G ELECTRIC REG. U.S. PAT. OFF
Telescopic Hoist
With Automatic Stop and Gravity Lowering Device

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"WHITE STAR"

TRIPLE-ACTING *NON-RETURN*

REGULATING BOILER CHECK VALVE



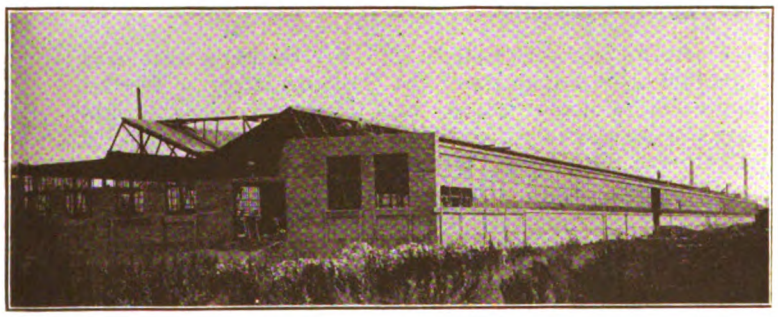
Isolates the Boiler in Case of Accident

The Powell Triple-Acting Boiler Check Valve safeguards lives and protects property. If a boiler tube blows the valve closes, and the boiler is thus isolated from the rest.

All Powell Valves are thoroughly tested and guaranteed. Write for circular.

The Wm. POWELL CO.
2525 SPRING GROVE AVENUE
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POWELL VALVES



Construction Costs
Have Reached the Bottom!

THE cost of building factory structures is at the lowest point since 1913. The increase in demand for additional manufacturing space which is already following the resumption of activities in many lines will soon produce an increase in building costs. Those who need factory space but have waited for the lowest point in building costs can profit by building during 1922.

An additional saving can be made by employing "MRBN" Engineers to plan the building for you. Write for one of the members of our firm to come and outline to you our method of handling the design of industrial buildings at minimum cost to you.

Thirty Years
MRBN
of
Industrial Buildings

Build Now!

MILLS · RHINES · BELLMAN & NORDHOFF
Engineers
TOLEDO · OHIO

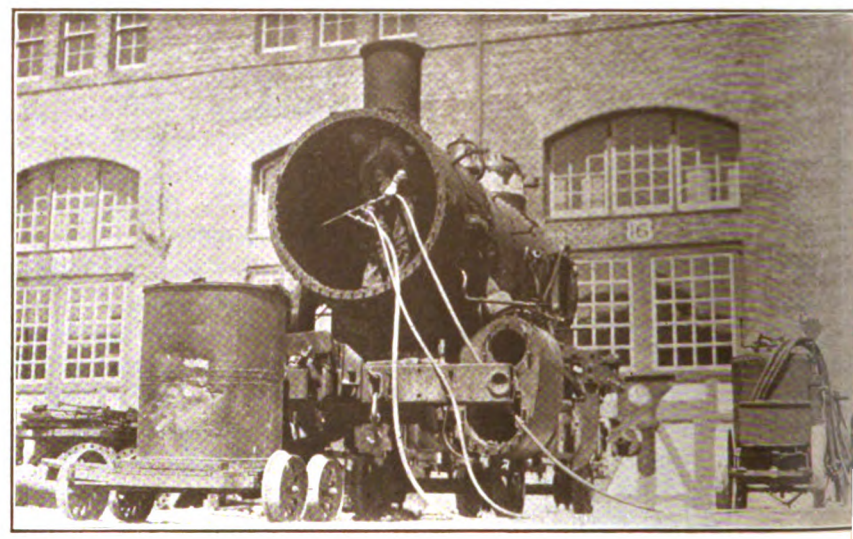
As these processes made steel both more plentiful and cheaper, its uses became more widespread; and intelligent study resulted in an infinite variety of steels for special purposes.

There is perhaps no substance in such universal use, for which it would be as difficult to find a substitute, as steel. It is hard to name any article of food, clothing, shelter—any luxury or necessity of modern life——which does not depend for its production on steel. No other metal can be made to do one-tenth of the things steel can and does do for us; not all the other metals together can perform its wide range of duties.

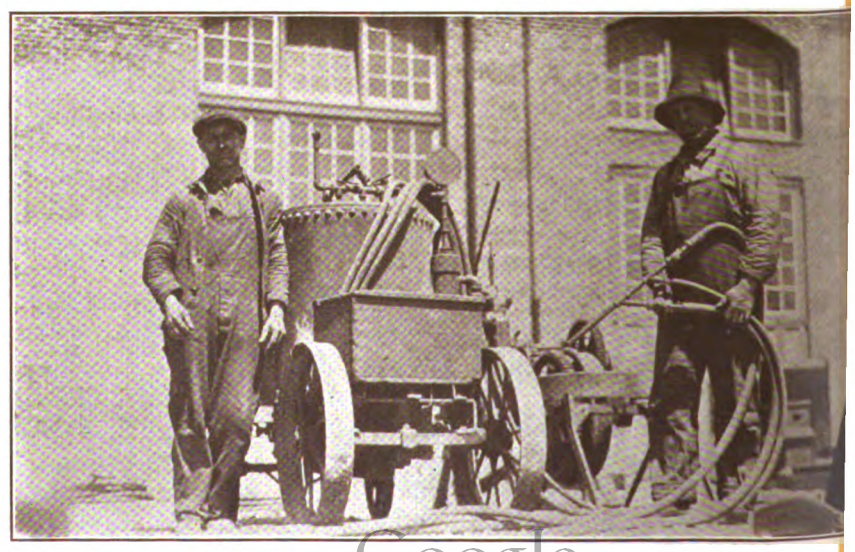
A century ago, this country made less than three percent of the world's steel, while today we make more than all the other countries combined; and the greater part of this increase took place in the last fifty years. In those same fifty years, the world's use of steel has increased from approximately seven hundred thousand tons (1870) to almost sixty million tons.

Little wonder that the Steel Dragon belches his hungery of "Tonnage — More tonnage!"

Using Sand, Compressed Air and Water to Clean Boilers



THE accompanying photo shows a device that has been perfected and placed in operation by the Southern Pacific Railroad in which water at 125 pounds' pressure is mixed with compressed air, and sand, and the mixture directed against boilers and boiler flues by a special gun, the purpose being to clean the scale from the flues and boiler. By means of this combination the scale is not only entirely and quickly removed but as it is removed it is washed down with the water and sand, leaving the flues and boiler perfectly clean. There is no dust or sand floating around in the air, as is the case when sand is used with compressed air alone.



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For Storing, Reclaiming, Loading, Unloading or Transferring coal and similar material.

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Quality

WHEREVER Efficiency in handling is important you will almost always find the Scoop Conveyor.

Efficiency depends on reliability and reliability along with other portable conveyor requirements depends on quality. And quality is the first Scoop Conveyor virtue.

For the sake of such quality nothing is ever left undone. Quality comes first. It is built in at the factory. It comes forth in faithful performance.

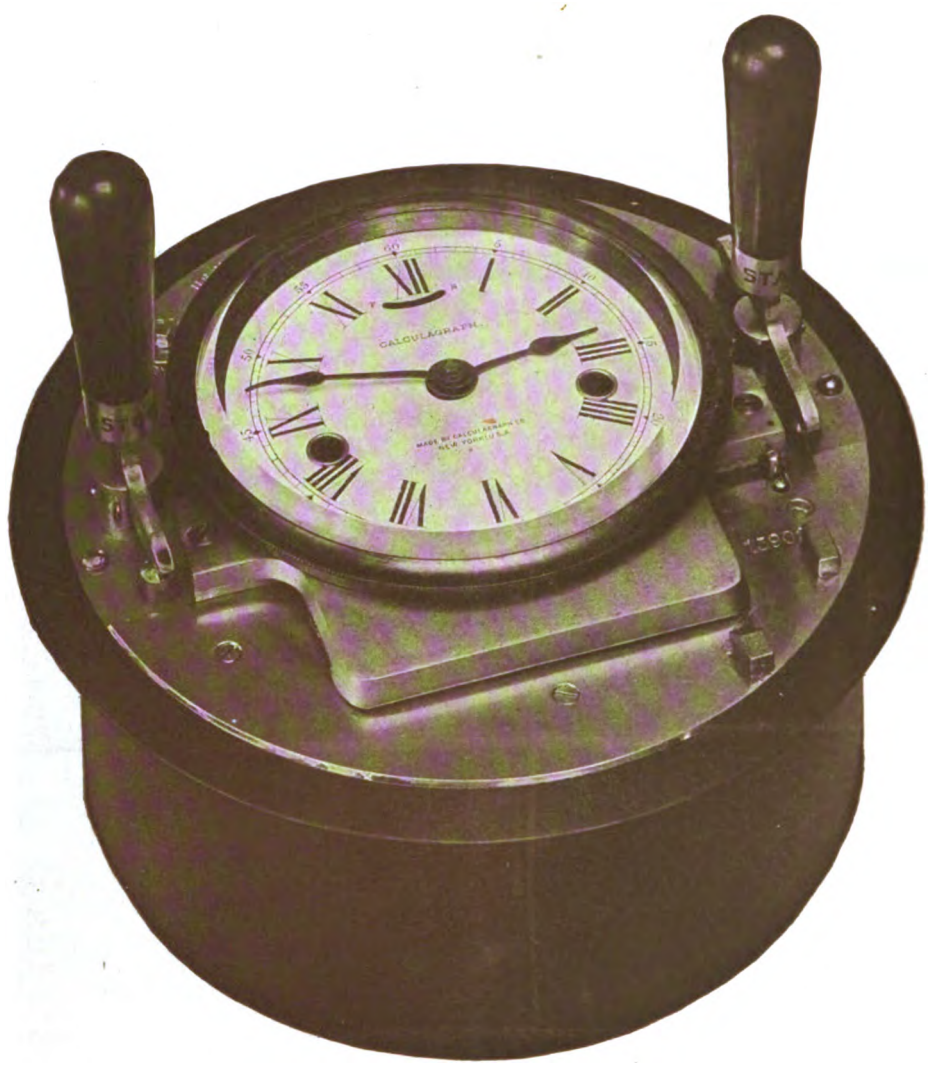
Thousands of users who know the Scoop Conveyor best, appreciate most, what these statements mean.

Write for our Catalog No. 63.

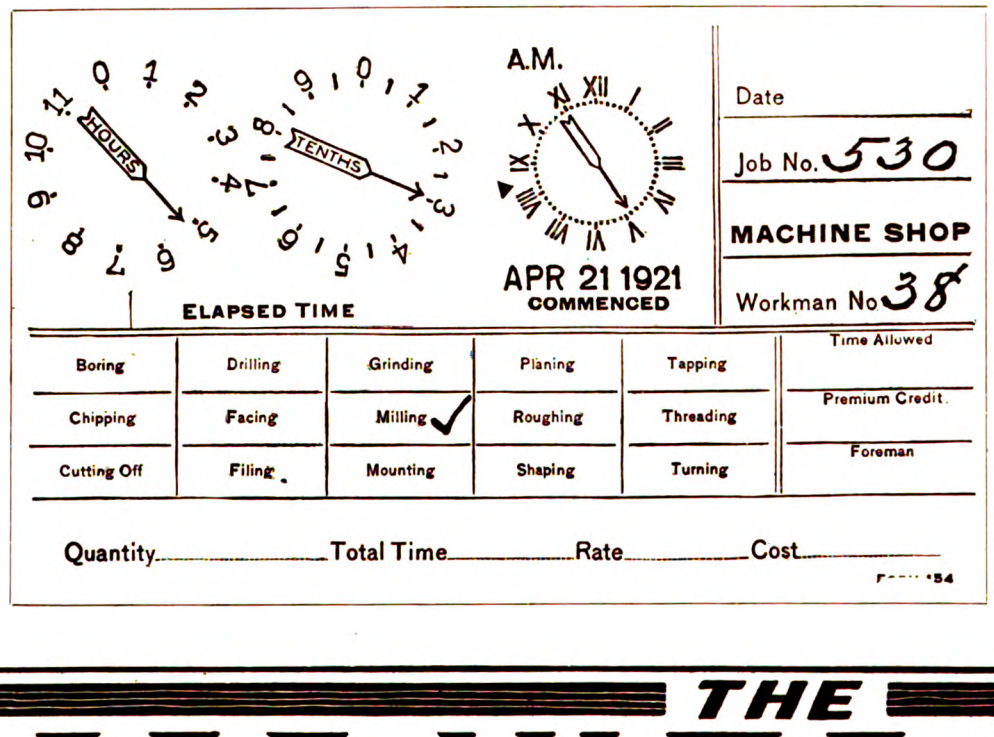
Portable Machinery Co., Passaic, N. J.

THE SCOOP CONVEYOR

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The Calculagraph Way



One backward-forward movement of the right-hand Calculagraph lever when the job starts, a pull on the left-hand lever when the job is done, and the time record is complete.

The complete Calculagraph record reproduced opposite shows that a workman began milling job No. 530 at 8:24 A. M., April 21, 1921, and that the operation took five and three-tenths hours (hours and minutes printed if preferred). The elapsed time record is read directly from the card, without any figuring or possibility of error.

Any number of employees can use one Calculagraph without confusion of records.

THE CALCULAGRAPH

THE ELAPSED TIME RECORDER

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Call Any Town 33 Miles or More from Your Office---

It's a safe bet that the time of your conversation will be recorded by a Calculagraph—

Why?

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The reasons for this are the same as those which have caused it to be used in industrial plants the country over, the economical and dependable character of this **Time Recording Instrument.**

Economical, because it eliminates every chance of a personal equation entering into the time calculation, because it does not lose a single minute and because it needs no clerk to enter the figures on the workman's card or calculate the number of hours and minutes he has worked, for all these are automatically done by two pulls of the handle. Dependable because of its durable construction. There are no wiring or electrical troubles with a Calculagraph. Imprints are made on cards, obtainable from your own printer, by type that rotates continuously. The Calculagraph is operated by an 8 day, spring driven movement with jewelled balances and no matter how the hands of the clock may be manipulated, the elapsed time record cannot be falsified.

Send for your copy of
"Elapsed Time Records"

THE
CALCULAGRAPH
THE ELAPSED TIME RECORDER
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Do It Mechanically —by the Keller Method

The *sheet metal industries* too, have turned from obsolete hand die cutting to modern efficiency. Here are a few of the infinite variety of products from steel dies made on Keller Automatic Machines.



This pair of shovel dies was an easy task for a Keller Automatic Machine. By hand, the expense of steel dies was prohibitive.



Keller Machines reproduce the master accurately and rapidly,—hollowware, lighting fixture parts, builders hardware, are some of the lines benefitted by this method.



Small ornamental work or the largest automobile body and chassis dies are equally within the scope of the Keller Method.

For Fenders and Axle Housings—Dies and Punches are cut automatically and finished in less time than it used to take to rough out.

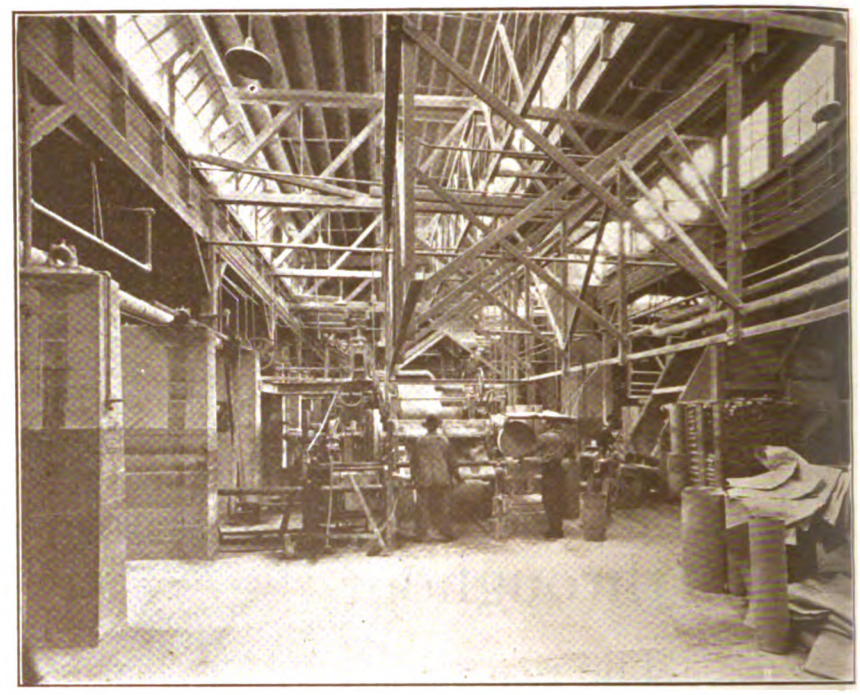
Keller Machines reproduce direct from plaster, wood or metal patterns—you can cut original or duplicate dies; also punches and forcers.

The Keller Method is applicable to every industry using Dies. Molds, Metal Core Boxes and Patterns.

ASK HOW IT APPLIES TO YOU

KELLER MECHANICAL ENGRAVING CO.,
58 Washington St., Brooklyn, N. Y.

Adding Machine Renders Valuable Service in Manufacturing Roofing



ADDING machines are now rendering valuable service in the roofing plant of the Paraffine Companies Inc. located at Emeryville, Cal.

Large jumbo rolls of felt weighing from 1200 to 1500 lbs. are placed on a reel and run through the machine shown above coming out at the end of the machine as shown in the close-up view, below, and being wound up into rolls of equal length. Each roll of roofing is weighed as it comes from the machine and registered on the adding machine. When the jumbo roll has all been used up the adding machine shows the total number of rolls of roofing obtained from that jumbo, the weight of each roll of roofing, and the total weight of all rolls obtained from each individual jumbo roll.

The engineers of the company spent considerable time in figuring out just how these results could be achieved, when they finally decided that the adding machines would do the work.

Because of the dirt and dust each adding machine is thoroughly cleaned by compressed air each month.



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The Evolution of Anti-Friction Bearings

(*Continued from Page 10*)

in point of workmanship was vastly superior to the chariots of Gaul and Belgium as well as Rome.

The pulley was also a mechanical contrivance of great antiquity. The first form of pulley was evidently a dead-eye designed to change the direction of a rope upon which a strain was placed. This in itself was an improvement over passing the rope around a pin, for the dead-eye was made of hard wood and had a smooth inner surface designed to reduce friction and wear on the rope.

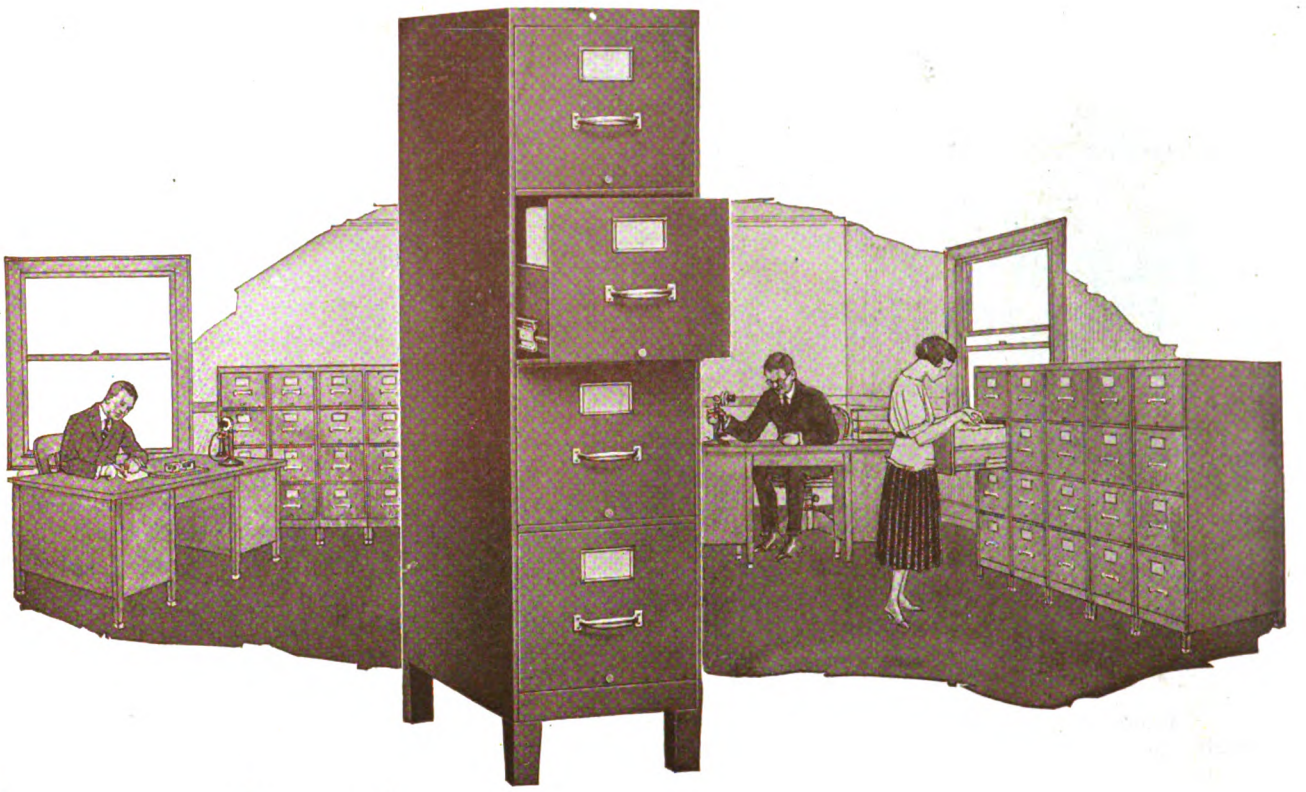
The modern form of pulley, consisting of a sheave wheel turning on a pin held in a block, is said to have been invented by Archytas, a disciple of Pythagoras, about 516 B. C. The existence of pulleys on the great ship built by Archimedes is indicated in history. They were used for hoisting stones into the towers for supplying the catapult and other engines of war and for hoisting and lowering the sails. Compared to the dead-eye or the plain pin this pulley involved the use of anti-friction bearings. The friction of the rope on the inner surface of the dead-eye was replaced by the friction of the wheel on the pin which meant that the rope would not wear out so quickly and the load was easier to hoist.

So far, the bearing surfaces spoken of were probably made of wood, but with the advent of iron the excellent mechanical qualities of this metal soon caused it to be applied to bearing surfaces. It is supposed to have been discovered in Greece in the fourteenth century, B. C. but may have been already known in Egypt, China, and India for centuries previous to this. The Jews appear to have been acquainted with two kinds of iron previous to the Babylonish Captivity: the "barzel," which was in common use, and the northern iron as well as steel. Chariots, axes, arrows, weapons of iron were mentioned in Hebrew history between 1490 B. C. and 1040 B. C.

Jeremiah and Ezekiel speak of iron and mention two varieties, one of which was called "bright iron" this was probably steel. We learn from the Iliad that at the time of the siege of Troy (1184 B. C.) iron was used in various ways including axles for chariots. Undoubtedly the main advantages of iron as a bearing metal were soon recognized by the various nations, as iron from that time on became an important adjunct in the development of the mechanic arts.

It is rather a far jump from the periods just mentioned to the seventeenth century, but the history of every nation shows that the science of mechanics lay dormant until the age of invention re-established the principles that had been evolved by the ancients and carried them to their present day perfection.

For thousands of years wheeled conveyances seem to have remained unimproved. The mechanical contrivances of the barbarous nations which had their rise between Egyptian civilization and our own were of the crudest form and far inferior to those developed



Announcing the new "Y and E" Commercial Steel File

—point by point—the best file "buy" ever offered

GENUINE "Y and E" quality and workmanship, electrically welded steel construction, real roller slides, standard "Y and E" drawer suspension—and all at *a price below anything* of its quality on the market. Without exception, the best file "buy" you've ever seen.

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1. Real roller slides and the same drawer suspension usually found only in high-priced files.
2. Ten inches more filing space than the average, making it the lowest cost per inch of usable space of any high-grade file.
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5. Standard "Y and E" construction, intermembering with the "Y and E" 5300 line of files.

See this file on display in all "Y and E" branch and agency stores. Or mail the coupon today for prices and details.

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Filing System Service, Equipment and Supplies
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Rochester, N.Y.

Please send information and prices on your new "Y and E" Commercial Steel File.

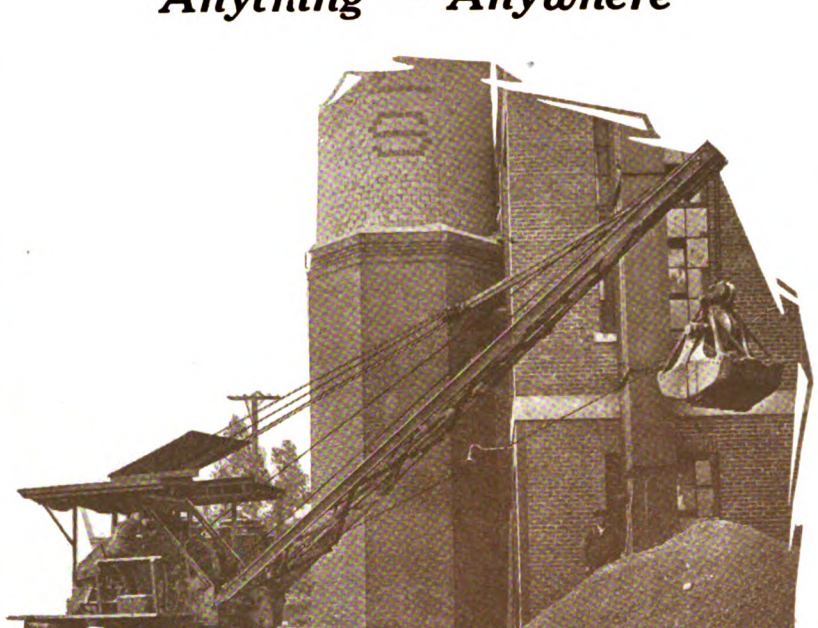
Name.....

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The "P & H" Handles

Anything — Anywhere



P&H CORDUROY CRANES

For the past 40 years Industry has been coming to P & H for Cranes. Industrial Engineers everywhere have been consulting us about their needs realizing that as builders of over 7000 Cranes of every nature P & H are competent to advise.

Recognizing an urgent need—some years ago—for a gasoline or electric-driven portable crane, P & H developed a line which requires no runway or tracks and which is unrestricted as to operating area.

These cranes, hundreds which have gone into use during the past eight years on all classes of work, are made up to the same standards of design and construction as P & H Overhead Cranes. The same craftsmanship is apparent in every part.

The P & H Corduroy Cranes run on their own corduroy traction—are operated by gas or electricity, require only one operator, need no tracks, and can maneuver about to any side of a railroad car or stock pile where needed. They are ready for service at the turn of a crank and can be stopped immediately. There is no objectionable smoke so that the machine can be operated indoors as well as outdoors.

Pawling & Harnischfeger are the only manufacturers of both overhead traveling and portable cranes in the United States. The recommendations of our Sales Engineers are therefore unbiased and you can place your problems before them with full confidence that their recommendations are not prejudiced.

In the industrial field the P & H portable crane is used with crane hook, magnet, clam shell or dragline bucket or with a shovel boom by such representative firms as Standard Oil, Mohawk Valley Mills, American Steel & Wire Co., North and Judd Mfg. Co., Western Pipe & Steel Co., and others.

PAWLING & HARNISCHFEGER CO.

Established in 1884

3850 National Avenue, Milwaukee, Wis.

New York	*Chicago*	*St. Louis*
Pittsburgh	*Philadelphia*	*Birmingham*
Salt Lake City	*San Francisco*	*New Orleans*
Los Angeles	*Denver*	*Phoenix*
Portland	*Seattle*	*Atlanta*

by the Greeks and Egyptians.

As the age of invention began to dawn, iron soon took its place of importance as the best metal in the manufacture of the rude looms and other textile machinery which really marked the beginning of the new era. The earliest experimenters found that cross-grained iron makes an excellent bearing metal. Being of a granular nature it has the property of retaining the lubricant in place even when highly polished and under pressure. It was, therefore, the logical metal for the bearings on the first machines and we find it was used universally.

Iron reigned supreme as a bearing metal until the nineteenth century, when an Englishman named Babbitt patented in 1839 his mixture consisting of a compound of tin, antimony and copper, set forth in his patent specification, as an "anti-friction compound especially adapted for the lubricated bearings of machinery." Here we have the first modern anti-friction bearing. Its advantage over cast iron is that, being a soft metal, it can be cast directly upon the shaft for which it is to form a bearing surface and adapts itself to irregularities of the shaft, forming a surface far superior to any which can be machined in iron. This theoretically, is an advantage but in practice we find that every babbitt bearing must be bored out to a diameter slightly larger than the diameter of the shaft to allow a place for lubricant. Unlike iron, moreover, babbitt metal is very brittle and will not stand shocks and strains, and therefore has to be backed up with iron or steel properly to perform its function.

Another advantage of babbitt metal was evident when it was found that the nature of the surface of this metal attracted particles of oil, allowing it to spread over the entire surface of the metal as a thin film. This film of oil is the most important point in the lubrication of those bearings where rubbing friction occurs.

Lubrication, as it is considered in mechanics, is the introduction of a smooth fluid substance, preferably an oil, between two hard moving surfaces to keep them from coming in direct contact. Unless the surfaces are kept apart by some medium, the asperities and irregularities which exist on all surfaces, no matter how smooth or hard, will interlock; and the friction caused in tearing them apart and wearing them down will generate heat. Oil performs its function as a lubricant by flowing between the close fitting surfaces, filling the interstices and forming a cushion. It also aids in dissipating any heat generated. We find, therefore, that Babbitt was entirely correct in naming his new discovery an anti-friction compound, because the friction between babbitt metal and iron is much less than that between iron and iron because the babbitt metal offers a surface upon which a film of oil can easily form.

During the nineteenth century, of course, new forms of bearings were being developed but no important improvement on the babbitt bearing was brought forth until in 187 when the properties of phosphorus bronze indicated that it possessed many advantages over babbitt metal. Bronze is rendered so liquid by the addition of phosphorus in the molten state that it forms very clean castings, filling the mold perfectly to the smallest detail. It has the added advantage of being much harder than babbitt metal and, therefore, shows wear very much more slowly.

From this time on evidence began to appear here and there of the use of ball and roller bearings of a rude nature. Probably all of us remember the old grindstone on grandfather's farm where each end of the axle rested on the peripheries of two small wheels set opposite each other which themselves turned on axles with plain bearings. Here the axle of the stone, in turning, caused the two wheels to turn, and the only friction existing between the surface of the axle and the peripheries of the wheels was rolling friction. Of course there was rubbing friction at the axles of the small wheels. This was clearly an anti-friction bearing whose function was to distribute the great load of the stone and the greater speed of its axle to the four axles of the wheels which turned at a slower rate of speed than the grindstone, in the ratio of the perimeter of the axle to the perimeters of the wheels.

The 1884 edition of Knight's American Mechanical Dictio

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ary mentions anti-friction bearings (roller), anti-friction boxes (ball) anti-friction metal and anti-friction pulleys (roller) and it is evident that the basic principles of these bearings had been long understood; but since there was no demand for bearings of this type at that time they had not been developed much further than the experimental stage.

This was the condition of affairs when in 1884 an inventor began experimenting with sugar cane mills and perfected one far superior to any then used, both in the efficient manner in which it increased the percentage of pure extraction from the cane and in greatly diminishing the time necessary for the operation.

The principles of this machine being worked out, he was confronted with the impossibility of obtaining bearings in the market capable of satisfactorily standing the heavy duty required of the bearings in his cane mill. This directed his attention to the use of anti-friction bearings; that is to say, he wanted a bearing which would properly operate in his mill with less friction than any of the bearings then on the market, and he therefore directed his inventive genius to the development of a bearing to meet his requirements.

He tried different types of balls, including porcelain, agate and steel; and rollers, including wood rollers, solid steel rollers, short lengths of pipe and tubing with all kinds of retaining cages and housings. Each was partially successful but applied to the machine soon proved unsatisfactory and necessitated a fresh start.

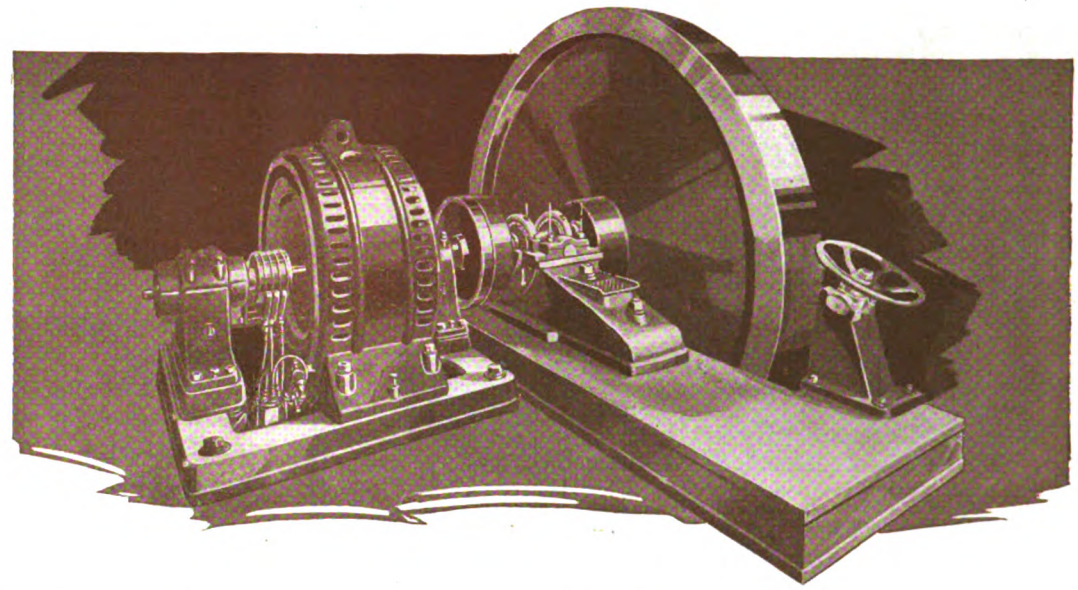
After years of patient research and exhaustive experimentation he finally evolved a satisfactory roller bearing using hollow flexible rollers, and in 1892 a company was formed for the manufacture of this bearing.

Small ball bearings of the cup and cone type were coming into extensive use on bicycles at this time and a real future for ball and roller bearings was assured. The birth of the automobile at about this period, a mechanism which required bearings of a superlative type, seems a coincidence. Ball and roller bearings were logically used on the first automobiles ever brought out and have ever since held a most important place in automobile design. Their unvaryingly successful use in modern machines of all types, on thousands of line shaft and in mine and industrial cars throughout the world proved them to be of truly economical importance.

Since their inception these anti-friction bearings have been constantly improved in design and material, until today they are as superior to the bronze bearing as was the bronze bearing to the wooden bearing of the first Egyptian chariot.

Anti-friction bearings, in replacing babbitt and bronze bearings, returned iron (in the form of steel) to the important place as a bearing metal which it merited by reason of its many excellent mechanical qualities. The reduction in friction obtained by the substitution of rolling friction for rubbing friction, the concentration of loads upon hardened surfaces allowing narrower bearings

SKF



Five Hours on its Own Momentum
—An Achievement Possible Only With Ball Bearings

FIVE hours of motion without power! Unbelievable—but nevertheless an actual fact, as demonstrated by this fly-wheel type alternator which revolved on its own momentum for five hours.

Four SKF marked self-aligning ball bearings are used to support the revolving parts running at 500 R.P.M. and weighing 44,000 pounds.

You can imagine then the amount of energy which the use of ball bearings, as compared with plain bearings, saves in the course of a year in any plant. Since the saving in each machine is added to that of the others, the total is no mean quantity and represents a substantial increase in plant efficiency and a worth-while economy.

When self-aligning ball bearings are used friction is practically eliminated and marked economies effected as well in lubrication and maintenance. See that your electrical machinery is ball bearing equipped.

THE SKAYEF BALL BEARING COMPANY
Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

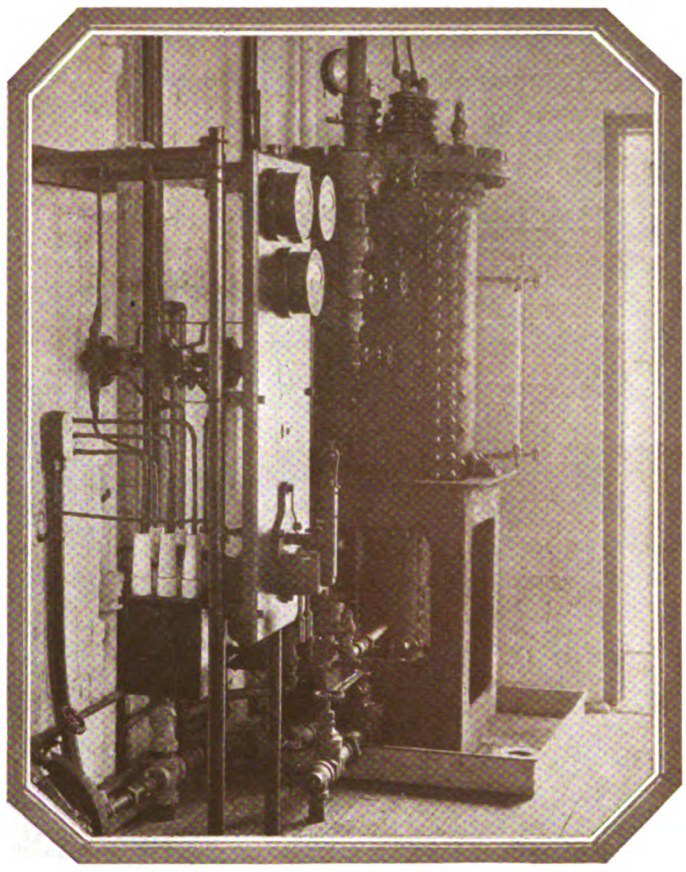
765



BALL BEARINGS
The Highest Expression of the Bearing Principle

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Steam *from* Surplus Electric Current



"ELECTRO" Steam Boiler—Capacity 100 KW (10B.H.P.) 2200 volts, 3 phase, 25 cycles, 80 lbs. gauge, installed for Frank & Lochner, Inc., by Volker Bros., Engineers, Buffalo, N. Y.

Many industries find that a portion of their electric power, particularly where it is contracted for by the year, is idle a part of the day.

The "ELECTRO" Steam Boiler is a solution to the problem of turning this waste energy into useful work. It generates steam by the passage of high voltage alternating current between electrodes immersed in water.

No coal or any other fuel is required. And the amount of steam generated, the pressure and the amount of power used is governed and under control—the regulation is obtained by the height of the water or the depth of the immersion of the electrode.

The "Electro"

Steam Boiler is adaptable to the following Industries:

Paper and Pulp
Lumber
Chemical
Electro-chemical
Textile
Hydro-electric Power Plants
Gas Plants
Silk Mills
Fruit Canning
Cement Mills
Central Heating Plants

The "ELECTRO" Steam Boiler has the following advantages over fuel-fired Boilers.

Low initial cost.
Space occupied for steam generated reduced to the minimum.
Thermal Efficiency 98%.
No expensive boiler and smoke-stack foundations.
No water softening required.
Fuel and ash handling equipment, oil storage, tanks, coal bins and railroad sidings absolutely elimated.
Lowest insurance rates.

The "ELECTRO" is built in several types and sizes in accordance with requirements. A number of large installations are in successful operation, including one of 20,000 kilowatts, capable of raising 60,000 lbs. of steam per hour at 130 lbs. pressure.

Send for further particulars.

ELECTRIC FURNACE CONSTRUCTION COMPANY
908 Chestnut St.
Philadelphia, Penna.

and therefore more compact designs, and the ease with which they could be entirely enclosed in housings, thus making for efficient lubrication, were advantages soon apparent to the engineering world.

All the bearings brought forth previous to the babbitt bearing, were improvements in both design and material. The effect of the invention of babbitt metal upon the general improvement of bearings can be shown graphically, with time and bearing improvements as ordinates.

A line drawn, from a point representing the stone dragged on the ground in the forty-ninth century B. C., to a point representing anti-friction bearings in the twentieth century A. D., will show the logical development of bearings throughout the ages. All of the bearings where improvements of design and material were simultaneous can be represented by points on this line.

The babbitt bearing was certainly an improvement in design, in that it eliminated friction; but this improvement was only attained by the substitution of a metal of poor mechanical qualities for iron, whose mechanical qualities are unexcelled. The babbitt bearing therefore denotes a break in the line of logical bearing development.

If the modern forms of ball and roller bearings had been invented in the early part of the nineteenth century, babbitt and bronze bearings would probably never have been used, because ball and roller bearings were a mighty step forward *both* in bearing design and in bearing material, and offered a practical release from the many disadvantages of the old types of bearings.

Why does the enormous annual waste of power, lubrication, and the money spent in replacing old fashioned bearings, still continue—in spite of the many advantages of anti-friction bearings? Because so many of the men upon whom rests the responsibility for bearing changes are afflicted with mental inertia, that intangible force which resists all change. Men who have achieved great things in machine design, in spite of the handicap imposed by soft metal bearings, are often blind to the much greater achievements made possible by the many advantages of anti-friction bearings.

The first wheel in Egypt was looked upon as an interesting improvement upon the sledge, admirable for the chariots of kings, but not of real importance to the majority of the men who had loads to convey. Are anti-friction bearings excellent for automobiles and not for other modern mechanisms?

In the face of the evidence presented by history there is no excuse for the use today of plain, babbitt or bronze bearings in any machine. It is an engineering and economic crime to construct machines of high grade steel, machined to close limits, and then use soft metal bearings which sacrifice all the excellent mechanical qualities of steel in order to secure a surface upon which a film of oil will readily form.

The ultimate universal use of ball and roller bearings in machinery of all kinds is the logical outcome of centuries of development and it is but a matter of time until all of the antiquated, wasteful, troublesome bearings of the early days of the age of invention will be replaced by modern anti-friction bearings and the very word bearing will convey to every engineer's mind these bearings in their most improved form.

Thinking

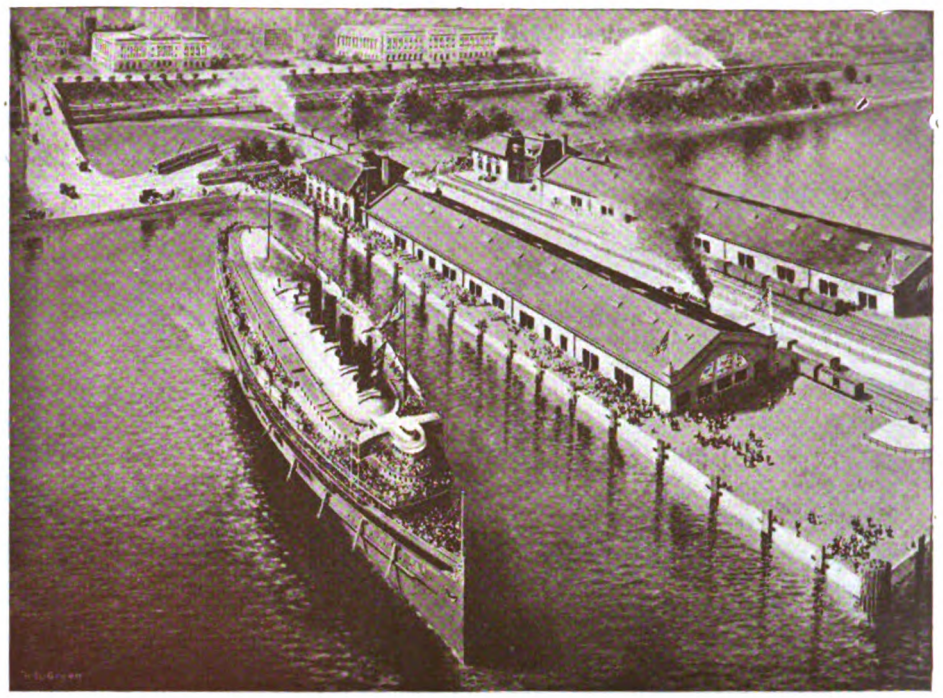
If you think you are beaten, you are;
If you think you dare not, you don't;
If you'd like to win, but you think you can't
It's almost a cinch you won't.
If you think you'll lose, you're lost,
For out of the world we find
Success begins with the fellow's will—
It's all in the state of mind.

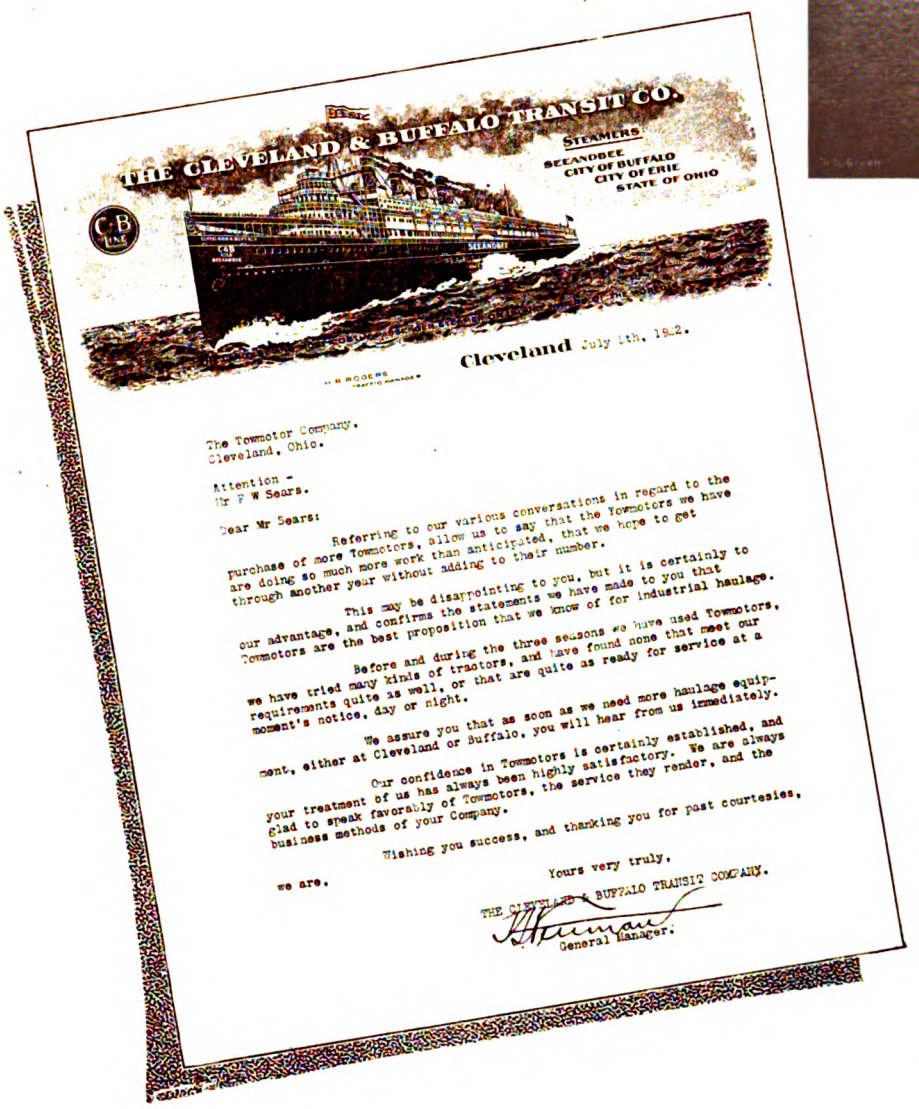
If you think you are outclassed, you are;
You've got to think high to rise.
You've got to be sure of yourself before
You can ever win a prize.
Life's battles don't always go
To the stronger or faster man,
But sooner or later the man who wins,
Is the one who *thinks* he can.

—Robert Burns.

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The great ship "SEEANDBEE" flagship of The Cleveland & Buffalo Transit Co. is **the largest and most costly** steamer on the inland waters of the world—is loaded and unloaded daily with the aid of TOWMOTORS.




THE CLEVELAND & BUFFALO TRANSIT CO.
STEAMERS
SEEANDBEE
CITY OF BUFFALO
CITY OF ERIE
STATE OF OHIO

Cleveland July 5th, 1922.

The Towmotor Company,
Cleveland, Ohio.

Attention -
Mr F W Sears.

Dear Mr Sears:

Referring to our various conversations in regard to the purchase of more Towmotors, allow us to say that the Towmotors we have are doing so much more work than anticipated, that we hope to get through another year without adding to their number.

This may be disappointing to you, but it is certainly to our advantage, and confirms the statements we have made to you that Towmotors are the best proposition that we know of for industrial haulage.

Before and during the three seasons we have used Towmotors, we have tried many kinds of tractors, and have found none that meet our requirements quite as well, or that are quite as ready for service at a moment's notice, day or night.

We assure you that as soon as we need more haulage equipment, either at Cleveland or Buffalo, you will hear from us immediately.

Our confidence in Towmotors is certainly established, and your treatment of us has always been highly satisfactory. We are always glad to speak favorably of Towmotors, the service they render, and the business methods of your Company.

Wishing you success, and thanking you for past courtesies,

we are.

Yours very truly,

THE CLEVELAND & BUFFALO TRANSIT COMPANY.

General Manager.

TOWMOTORS

are in constant use

At both terminals of The Cleveland & Buffalo Transit Co., whose fine ships and splendid service are the admiration of every patron of this popular line.

The "SEEANDBEE" which carries hundreds of tons of freight and fuel in addition to its passenger list, makes the trip from Cleveland to Buffalo over night, is unloaded there in the morning, loaded again in the afternoon and returns to Cleveland that night. The "City of Buffalo" alternates with the "SEEANDBEE," completing the service.

These boats must run true to schedule. Freight and fuel must be handled efficiently and expeditiously. For this work TOWMOTORS are used, and in the past three years of uninterrupted service, they have made themselves indispensable to The Cleveland & Buffalo Transit Co.

The accompanying letter expresses their opinion, and is a convincing argument for the use of TOWMOTORS wherever uninterrupted service—twenty-four hours a day if necessary—is essential.

THE TOWMOTOR COMPANY

1226 East 152nd Street **Cleveland, Ohio**



THE TOWMOTOR

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NOW is the Time to PLAN for An Ever-Available Coal Supply!



BUILT STRONGER LASTS LONGER

Delay—and thousands of dollars may be the penalty. Strikes on the railroads and at the mines do not await your preparedness. A depleted coal supply would cost you a mighty big sum in lost orders and expense incident to interrupted factory production.

Plan *now* for an ever-available supply. A G-W Ground Storage Plant, similar to the one above, would provide it—would assure an auxiliary coal supply to tide you over a coal shortage. Quick installation, low initial cost, and minimum maintenance are the advantages of its unusually simple construction. It utilizes waste ground area and in most all instances can be erected without changes to, or interfering with, existing equipment.

Now is the time to plan. Gifford-Wood Engineers and our many years of experience are at your disposal. G-W Coal Handling Equipment includes every type—complete plants down to wagon loaders and portable belt conveyors. We'll gladly have a G-W representative call on you or, if you prefer, send a catalog first.

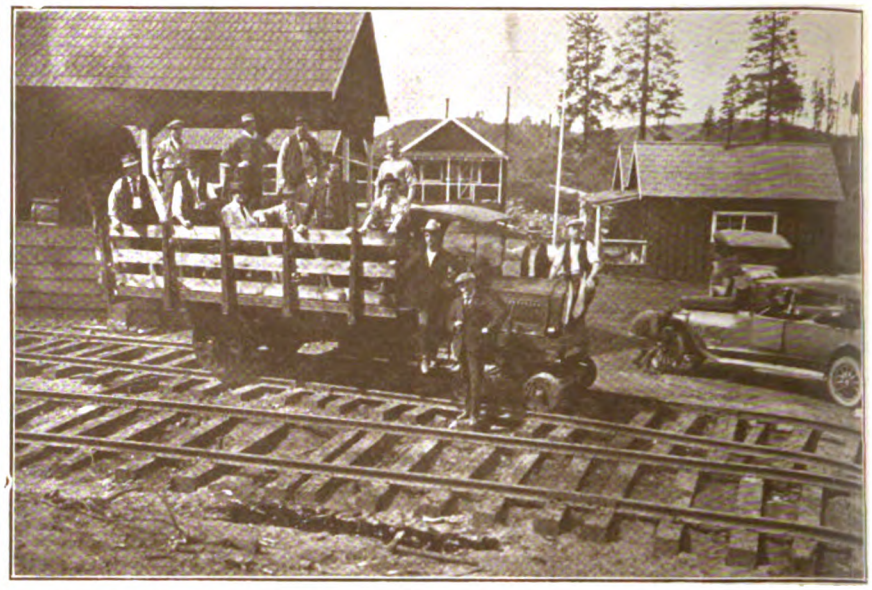
MAIN OFFICE & WORKS: HUDSON, N. Y.

New York Chicago Boston Buffalo

2094-R

Gifford-Wood Co.

COAL HANDLING EQUIPMENT



Automobile Trucks on the Hetch Hetchy Railroad

A FLEET of automobile trucks are now rendering valuable service on the Hetch Hetchy Railroad, which is operated by the city of San Francisco in the construction of the Hetch Hetchy Power and Water project.

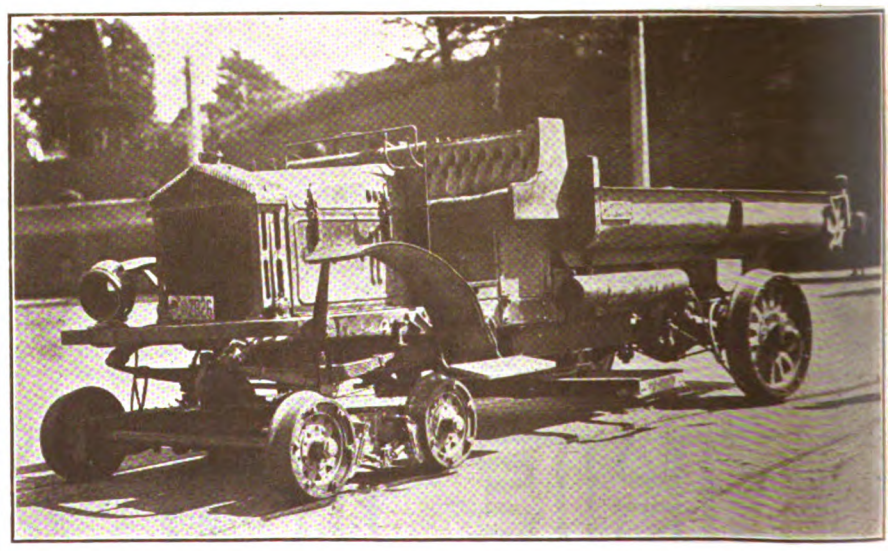
The trucks are equipped with flanged wheels in the rear and pony trucks in front. The front of the chassis is mounted on a ball bearing center plate and roller side bearings, which eliminate friction.

The cars carry their own turntable, which consists of a structural steel frame bolted together and fastened in the center of the car. By jacking up under the frame, sufficiently to raise the wheels above the track, the car can be turned end for end. This frame is plainly seen beneath the truck in the illustration below.

Sand, for tractive purposes, is forced on the rail in front of the rear wheels by means of compressed air. The sand is carried in a box in front of the rear wheels. In front of this sand box is a cylinder, in which air is compressed by an air compressor operated from the main motor.

The brakes on the pony trucks operate in a manner similar to the brakes used on the ordinary power hand car. These brakes operate in conjunction with the rear brakes.

Some of the trucks are interchangeable, and can be equipped with a dump body as shown below, or with the body shown at the top of this page, this latter car being engaged in regular express service along the line.



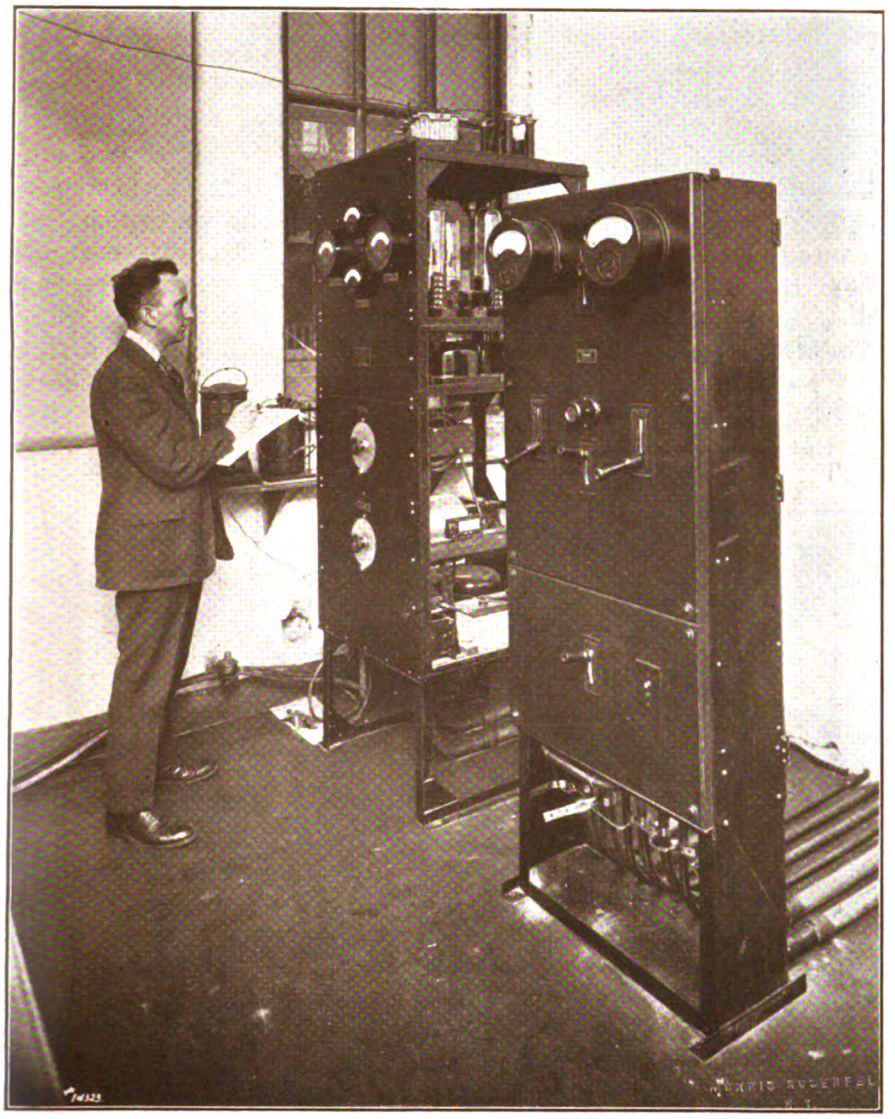
Note the frame amidships, which allows jacking up the truck so that it can be turned end for end.

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"WBAY"

The New American Telephone and Telegraph Company Toll Broadcasting Station

ON Thursday evening, August 3, in a little room on the top floor of 24 Walker Street, New York, eight men stood in breathless silence, listening to the bed-time discourse of "Uncle Wiggly" that issued from the loud speaker hung from the ceiling. All of the men were watching the big clock on the wall. Seven-twenty-nine, it registered, Daylight Saving Time.

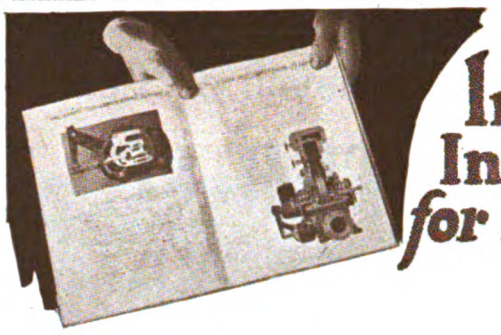


Here is Robert Fennimore, A. T. & T. engineer who has worked tirelessly for weeks to get "WBAY" into the pink of operating condition, checking up on his handiwork. By watching the ammeter at the upper right of the panel just in front of Mr. Fennimore, it is possible to trace the modulation of the voice of a speaker when the station is sending.

And then, as Uncle Wiggly's station signed off and thousands of listening youngsters theoretically lapsed into wrapt slumber, a man standing in front of a switchboard pushed a button. In the studio room, two doors down the hall, a buzzer spoke, and C. W. Peck began his talk that marked the official opening of "WBAY," the toll broadcasting station of the American Telephone and Telegraph Company, in New York.

In the entertainment that followed, musical selections were rendered by Miss Graves, Mrs. Swayze, Miss Mills, Miss Hermann, Mr. Joseph Koznick, Mr. Harry Armstrong and Mr. F. R. Marion. Frank Graham who keeps baseball fans supplied with the latest diamond chatter with his stories in the New York Sun, talked to the radio fans about the pennant chances of the New York teams and threw in some personal sidelights on many headliners.

Just outside the radio operating room stood a long table, on which rested half a dozen telephone instruments. Two minutes after "WBAY" began operating, these phones began ringing. Amateurs everywhere had been invited to



Important Information for Executives

A NEW general bulletin has just been issued on steam turbines. It is a simplified, condensed text book on the design and application of non-condensing, condensing, bleeder and mixed pressure turbines, and of reduction gears. It is free from highly technical explanations and in fact, the British Thermal Unit (B. T. U.) is not mentioned once therein. The steam turbine occupies a definite position in the engineering world of today and its use is not a question of personal fad or fancy but of economic necessity.

There are many special applications throughout the industrial field for turbines in the smaller non-condensing sizes which make big money savers. The money savings which can be effected depend more upon the conditions under which the non-condensing turbine operates than on the actual efficiency of the turbine itself. The facts contained in this bulletin will materially help you in determining what conditions favor the application of the various types and with its many illustrations will clearly explain to you the mechanical construction and uses of each. Write now for your copy of Bulletin Z-25.

T-785

THE TERRY TURBINE

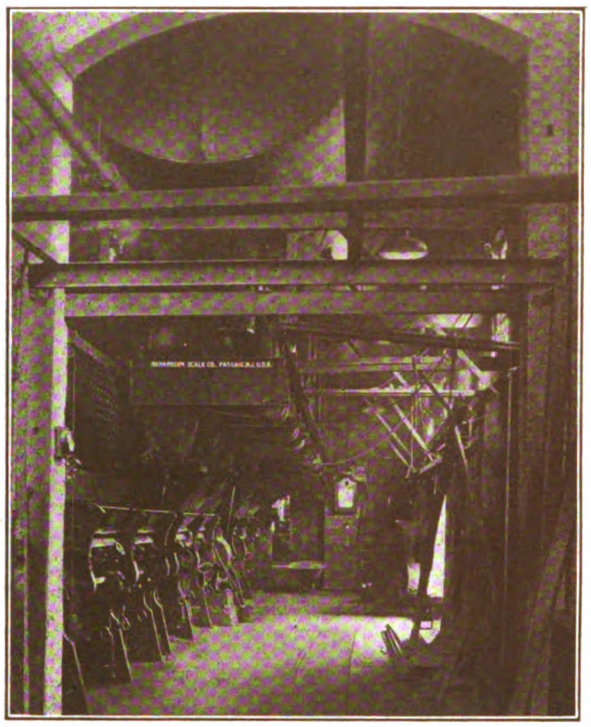
Offices in Principal Cities in U.S.A. also in Important Industrial Foreign Countries

The Terry Steam Turbine Co. Terry Sq. Hartford, Conn. U.S.A.

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If a Boiler Is Using An Extravagant Amount of Coal—

GET AFTER IT! Harness Your Power



USE THE RICHARDSON AUTOMATIC COAL SCALE

To check the consumption of each individual boiler in your plant

YOU'LL GET BETTER EFFICIENCY AND SAVE MONEY ON YOUR COAL BILLS

Accurate continuous records of consumption automatically registered by the machine. Scale weighs any kind of coal successfully. Wet or frozen lumps won't faze it. Absolutely sulphur proof and rust proof.

Faulty Draft regulation, improper firing, soot, scale, holes in the fire, all tend to lower the efficiency of a boiler. A RICHARDSON will locate the trouble and you can correct it.

Supplied in the following standard sizes:

200 lb. size,	1	ton hopper, capacity	6 tons per hour
300 lb. size,	1½	ton hopper, capacity	9 tons per hour
400 lb. size,	2	ton hopper, capacity	12 tons per hour
500 lb. size,	3	ton hopper, capacity	20 tons per hour
1000 lb. size,	5	ton hopper, capacity	40 tons per hour

RICHARDSON SCALE COMPANY

Passaic, New Jersey

New York Boston Buffalo Chicago Minneapolis
Omaha Wichita San Francisco Memphis Atlanta

call the station and say how they were getting the newcomer in the field of aerial entertainment.

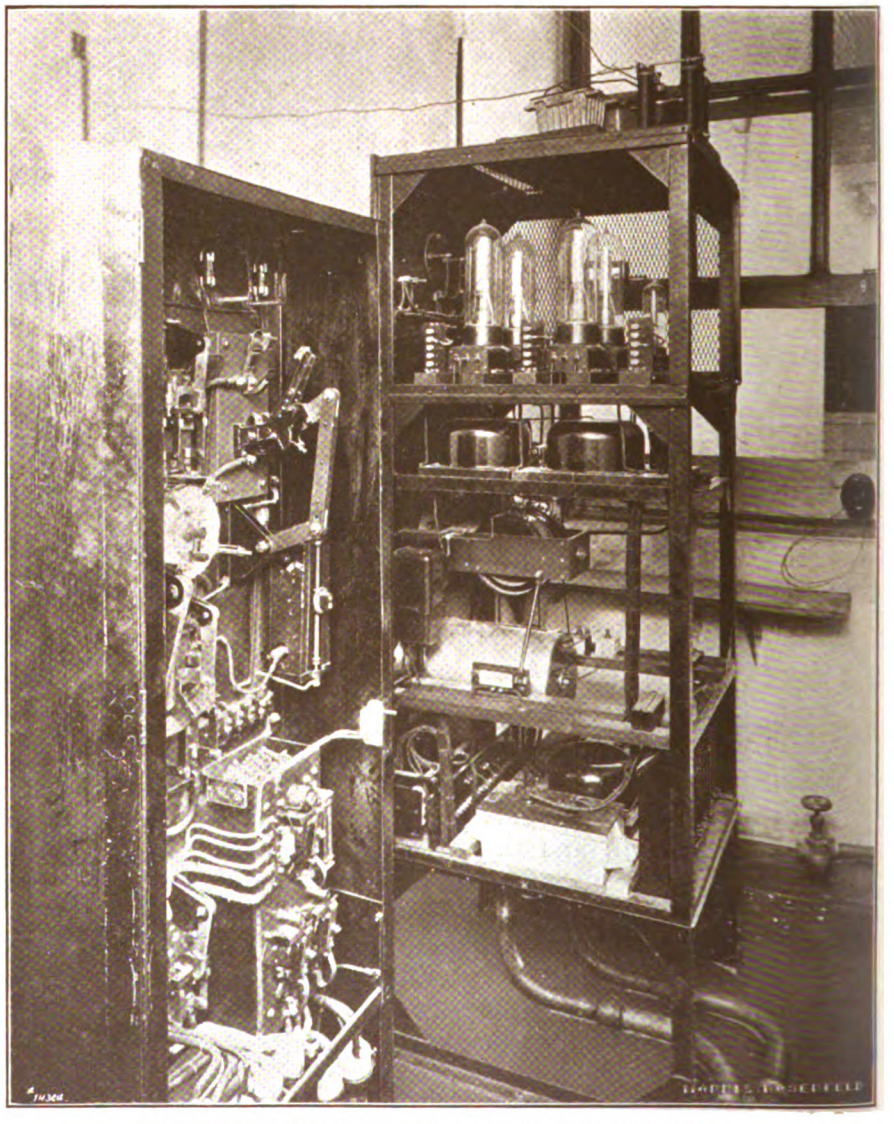
From Coney Island, Princeton, Montclair, Yonkers, Union Hill, River Edge, Larchmont, Patterson, and dozens of other towns the calls came in. Men with crystal sets expressed their pleasure of getting piano music clearly. An operator in South Jersey with a two-bulb set complained of a crackling noise, but thought a local thunder shower might have had something to do with it. And from thirty miles out on Long Island came the report of a fan with a loop set mounted in his car. He was traveling around, he said, and picking up "WBAY" every time he stopped.

One of the Company's telephone men in Princeton, N. J., called up and said if the boys wanted to see how he was getting them over his own set they could listen on his wire. They did listen, and heard in the receiver the voice of the soloist two doors down the hall in the studio room—a voice carried through the transmitting apparatus to the ether, converted at Princeton from electric waves to sound, and then relayed back as infinitesimal currents over the telephone.

Back in the days when radio was beginning to grip the heart of the public with its fasination and its mystery and its novelty, requests began to come in to the American Telephone and Telegraph Company for apparatus suitable for broadcasting. Theatres wanted to broadcast. All sorts of individuals and groups and organizations with a message to deliver to the public wrote in to ask for prices on equipment that would enable them to put their stories into the air.

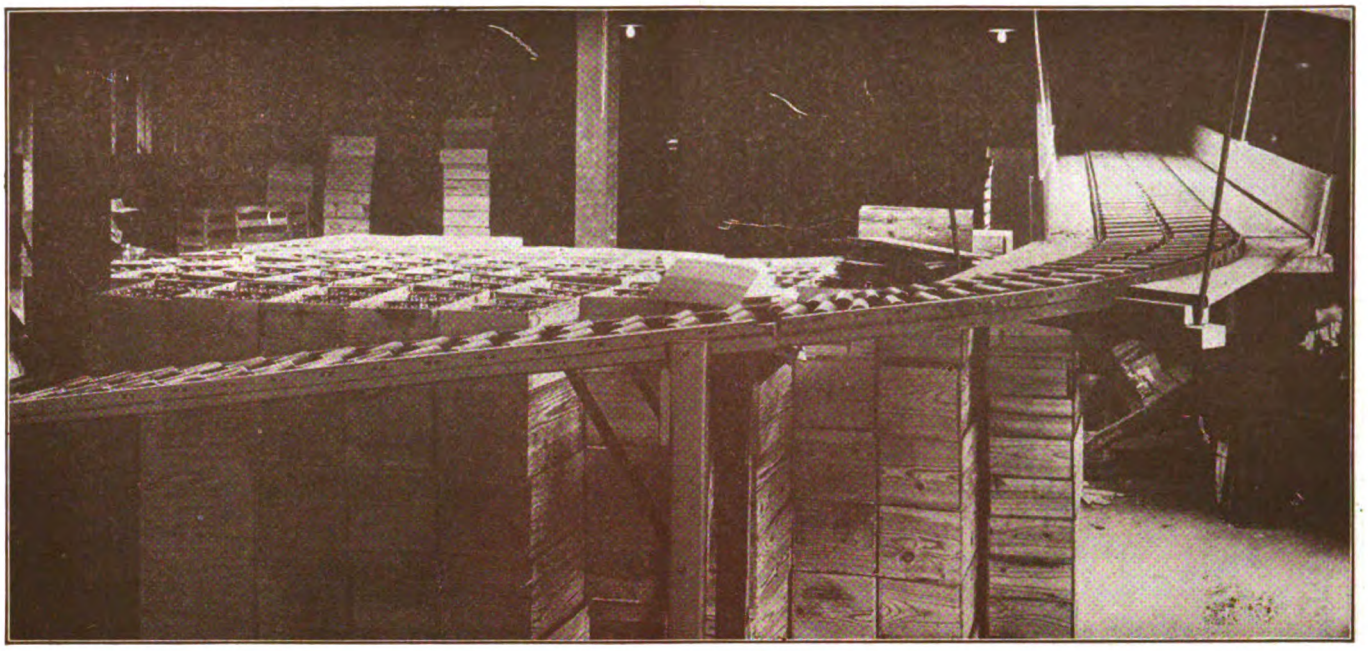
There were two main factors in the situation which these potential broadcasters did not realize at the time: First, that there is such a thing as interference when dozens of differing a thoroughly up-to-date station is too high to justify

(Continued on Page 46)



Rear view of the transmitting apparatus showing the power panel and the four 250-watt vacuum tubes, two of which act as oscillators and two as modulators. The 50-watt tube for preliminary amplification of the speech is also shown.

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More Speed—Less Cost in Conveying

From one end of your building to another, through crowded stock rooms, to or from the shipping rooms, cases of bottles and cans are carried quickly and smoothly by the force of gravity. Labor expense is cut, breakage loss reduced, unnecessary and costly delays are eliminated. The

MATHEWS
SPEED ECONOMY
GRAVITY ROLLER CONVEYER

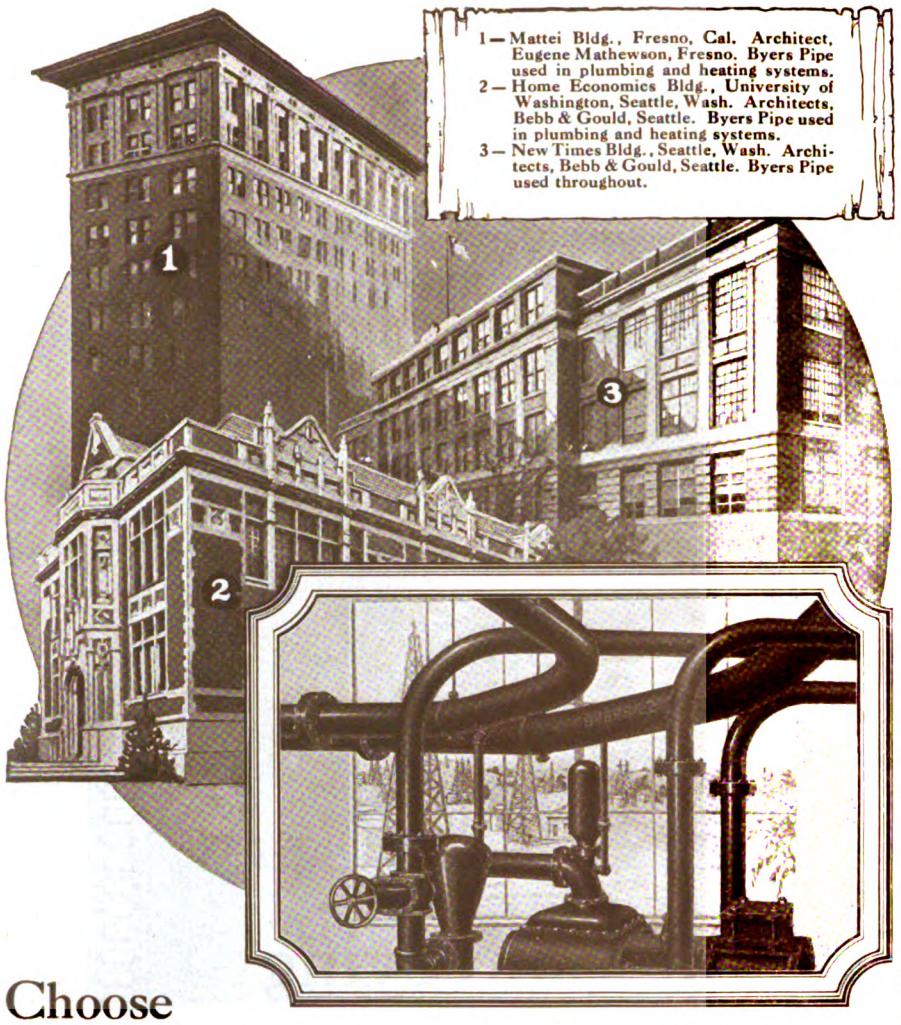
provides the simplest and most satisfactory utilization of gravity for conveying that can be had. It is the logical and lasting solution of your conveying problems and raises the general efficiency of your plant. It is manufactured in portable sections which make a flexible system readily adaptable to all parts of your building. Switches and other ingenious devices permit the routing of different products at will.

It is imperative that manufacturers take measures to offset labor shortages. The installation of a Mathews Gravity Roller Conveyer is a safeguard that pays for itself in labor saved. Our engineers are prepared to study conditions in your plant and estimate on the conveying system particularly adapted to your needs. Their advice places you under no obligation.

Write for further particulars.

MATHEWS GRAVITY CARRIER CO.
157 Tenth St., Ellwood City, Penna.
Branch Factories: Toronto, Ontario—London, England

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1—Mattei Bldg., Fresno, Cal. Architect, Eugene Mathewson, Fresno. Byers Pipe used in plumbing and heating systems.
2—Home Economics Bldg., University of Washington, Seattle, Wash. Architects, Bebb & Gould, Seattle. Byers Pipe used in plumbing and heating systems.
3—New Times Bldg., Seattle, Wash. Architects, Bebb & Gould, Seattle. Byers Pipe used throughout.

Choose Your Architect or Engineer Wisely— *Then Rely on Him!*

EVERY so often we hear owners and managers of comparatively new buildings say: "We use Byers pipe for all replacements. If we had known as much about pipe when this building was put up as we do now, we would have used Byers pipe in the first place."

Frequently this statement comes from people who have disregarded the advice of their architect or engineer on the subject of pipe material.

The experience of these owners and managers with cheap pipe, ultimately makes them more confirmed believers in the economy of using Byers pipe than those who are fortunate enough to install Byers pipe at first, and who, therefore, miss the valuable, though exceedingly costly, experience which follows the installation of pipe lacking in rust resistance.

The replacement cost of plumbing, heating and power piping installed in buildings or laid underground, is staggering.

Good architects and engineers know this, and specify Byers to protect their client's investment as well as their own good name. Where such specifications are lacking, competitive bidding invariably leads to the installation of the cheapest pipe obtainable.

Byers Bulletin No. 38 contains Analyses of Items of Cost in a variety of pipe systems, with notes on replacement costs and corrosive conditions. Sent free on request.

A. M. BYERS COMPANY, PITTSBURGH, PA.
Established 1864

New York Philadelphia Boston Chicago Cleveland Houston

BYERS PIPE

GENUINE WROUGHT IRON

Look for the Name and Year rolled in every length

(*Continued from Page 7*)

its exclusive use by the average individual or organization. ent stations attempt to use the other at the same time. And,

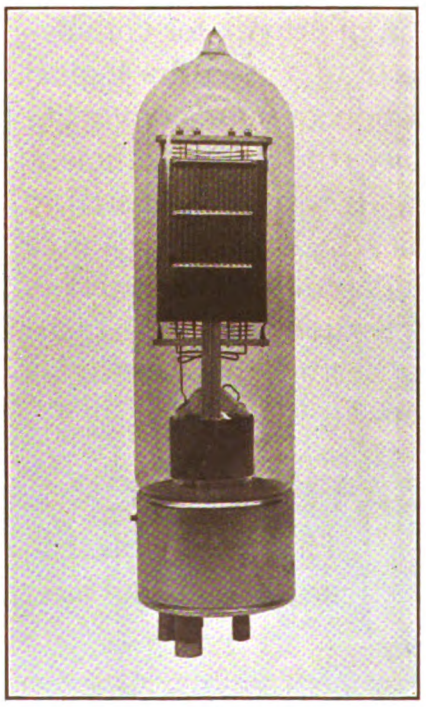


In the studio of "WBAY" every effort has been made to exclude echo in any form. Felt padding about the walls, and carefully planned arrangement get voice and music into the microphone with a minimum of distortion.

second, that the cost of installing, maintaining and operat-

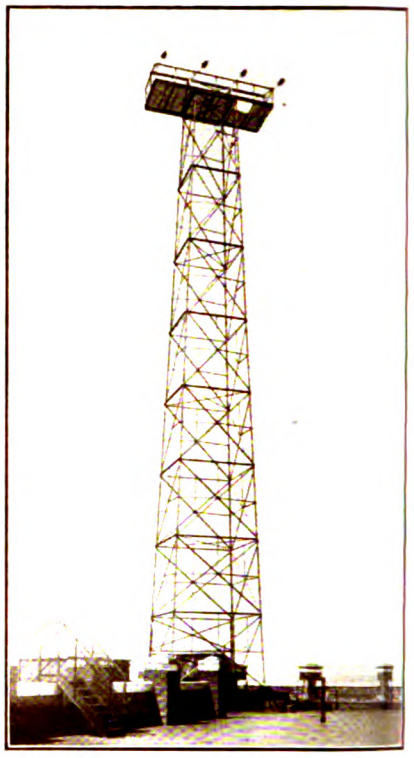
More and more it became evident that a demand had been created for a toll broadcasting service which might be used at stated intervals by organizations desiring such service for limited time. To meet this demand, the American Telephone and Telegraph Company set about the erection of one of the most modern and best equipped stations that the present state of the art permits. "WBAY" is the result.

From time to time the opinion has found expression that a station operating for hire like WBAY might work to the detriment of the broadcasting art. It was feared that a commercialization of radio broad-



The Western Electric 250-watt vacuum tube. These tubes operate at WBAY at a plate potential of 1600 volts.

casting might result which would tend to reduce the high quality and general interest of broadcasted programs. Such a result would be much regretted by all. In regard to WBAY all precautions are being taken to insure that its programs will meet with popular approval, and will consist of only such entertainment and other material as will have a general appeal. For it is a foregone conclusion that no one will wish to jeopardize his reputation by broadcasting what the radio audience generally does not care to listen to. Whether the motive be-



This tower, at the Lispenard Street end of "WBAY'S" antenna, is a hundred feet in height. It will stand a wind load of 5,000 pounds. The platform on top provides safety and comfort for men working aloft.

hind the broadcasting is to advertise merchandise or a public movement, or a candidate for public office, the fundamental requirement for the material will be wide popular interest.

Taking up the equipment in the order in which the sound waves pass through on their way etherward, let's step into the studio first. As you enter the room you notice at once that something about it is different. Your voice sounds unnatural to you. And the voices of your companions come to you more clearly enunciated than they did a moment before in the hallway. The room is echoless! This has been accomplished through the use of felt padding on the walls and parts of the ceiling, and by

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iving special attention to the rrangement of the room.

Like all the rest of the elec-rical equipment used in the tation, the microphone was esigned and manufactured y the Western Electric Com-any. With the type of micro-hone employed at "WBAY" ; is not necessary for the



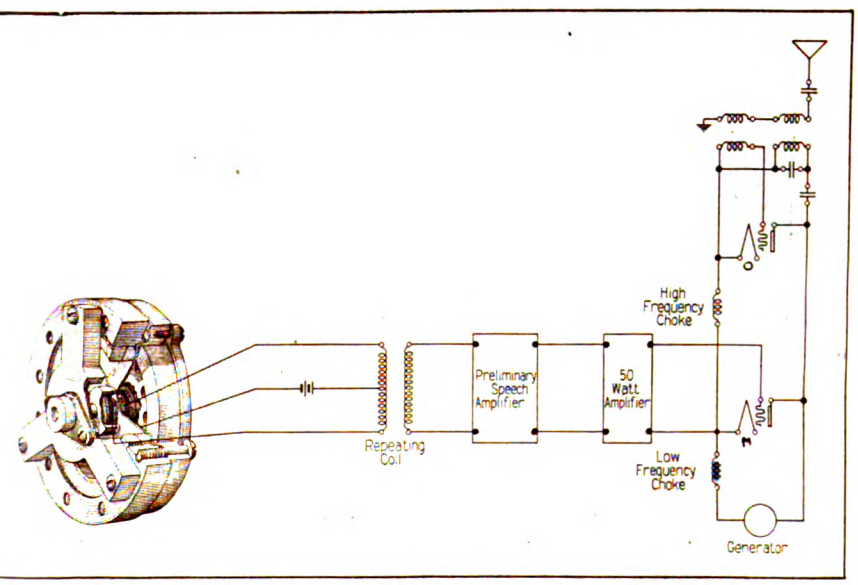
The sensitive microphone or telephone transmitter which is used in the studio to convert the sound waves of music and speech into electric waves. These are amplified many millions of times and radiated from the antenna.

speaker or singer to stand close to the instrument—a condition which adds materially to the ease of performance on the part of the artist. As one of our illustrations shows he, or they, may stand several feet away.

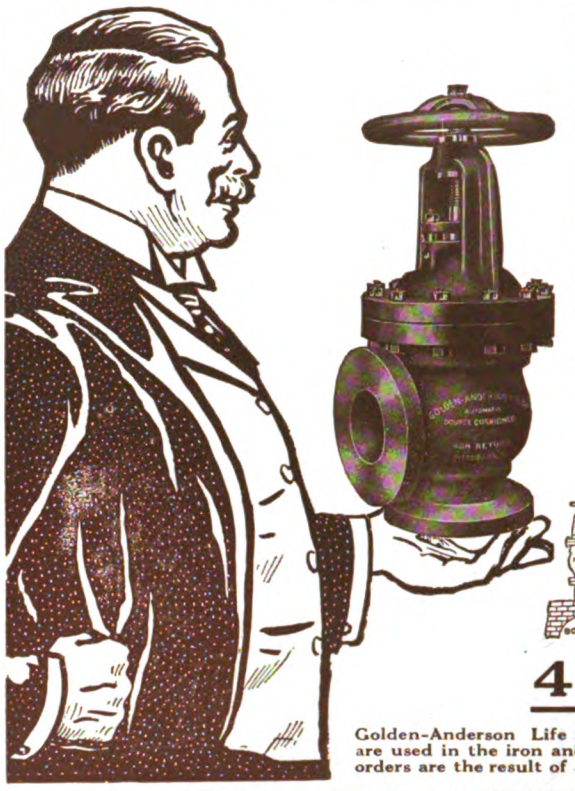
Two buttons, or carbon granule chambers characterize the Western Electric microphone used in this station. One button is located on each side of the vibrating diaphragm, so that at any given point in the vibration of the diaphragm, one buttom is compressing carbon granules while the other is releasing pressure. This means that current flow, affecting voice transmission, is being increased on one side of the diaphragm and decreased on the other.

Every fan who has studied the action of the single button microphone knows that its results are not exactly proportional to the amplitude of the sound waves producing them. Some distortion takes place. With the two-button device this distortion is cuut down tremendously. From the wiring diagram it will be noted that the two buttons of the microphone are connected with one side of the transformer—or in telephone language, the repeating coil—in such a way that the resulting currents are both in the same direction and their combined effect is the production of waves that are quite free from distortion.

Another interesting feature of this microphone is the method of damping the vibration of the diaphragm by means of air holes, through the framework. These air holes give access to a cushion of air that is only about 1/1000 of an inch thick between the diaphragm and the body of the transmitter. As the diaphragm vibrates, air is rapidly pumped in and out of this cushion. Ordinarily one does not think of air as a viscous fluid. At high vibration periods however the diaphragm finds the air of considerable viscosity and the pumping effect which results from this "air pump" action renders the instrument



Circuit diagram from push-pull transmitter through the speech amplifiers to the radio set. The Heising system of modulation is used. By the use of a microphone with two buttons working in opposite phases and joined to the repeating coil as shown, practically all of the distortion of the ordinary microphone can be eliminated.



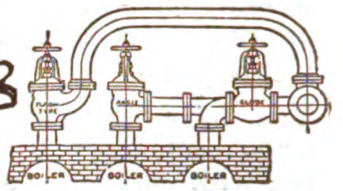
DOUBLE EXTRA HEAVY VALVES

"Every Valve Sold with a Positive Guarantee."

"Hosts of References."

"No Shut Down when a Boiler Tube Bursts."

"The Heaviest Valve Made"



4100

Golden-Anderson Life and Property Insurance Valves are used in the iron and steel industry. Their repeat orders are the result of assured protection.

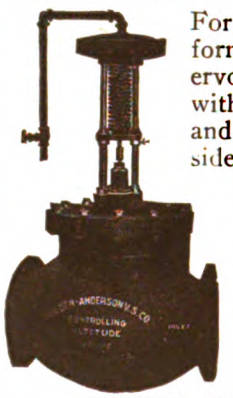
GOLDEN-ANDERSON

"Life and Property Insurance Valves"

Patent Automatic Double-Cushioned Triple-Acting and Non-Return Valves

1. They will automatically cut a damaged boiler out of service—making it impossible for live steam to pour back into it and cause a disastrous explosion. The other boilers are left intact, and can be continued in operation.
2. They will automatically shut off the steam flow from all boilers the moment that a pipe ruptures, thereby eliminating a pipe explosion.
3. A fresh boiler is automatically cut into the line, eliminating the serious danger involved when doing this by hand.
4. The pressure is automatically equalized between all boilers.
5. No steam can be turned into a cold water boiler, thus protecting men working inside.
6. Fitted with double Corliss dashpot which insures perfect cushioning in opening and closing.
7. No pounding, sticking or spinning
8. The only valves that can be tested in service.

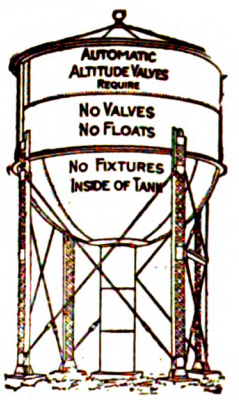
Golden-Anderson Automatic Cushioned Controlling Altitude Valves



For automatically maintaining Uniform Stage of Water in Tank, Reservoir or Standpipes. Doing away with the annoyances of Freezing and Float Fixtures inside or outside of Tanks. Three Ways of Closing "These Valves."

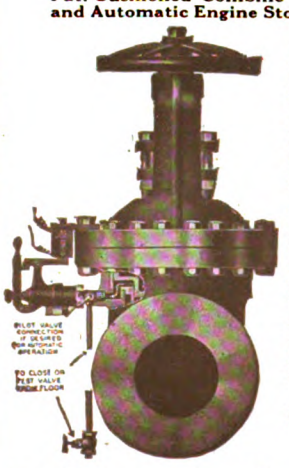
1st—Automatically by Water.
2nd—By Electricity, if desired.
3rd—By Hand.

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so connected as to "work both ways" on a single line of pipe.



GOLDEN-ANDERSON

Pat. Cushioned Combine Throttle and Automatic Engine Stop Valves



1—Can be operated by electricity from distant points insuring instant checking of steam to runway engine, or any part of the entire plant piping system.

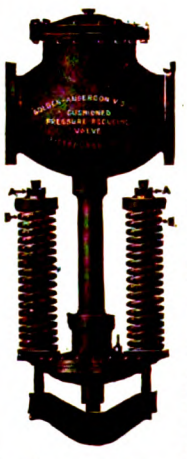
2—Equipped with double Corliss Dash Pots. No chattering, pounding or sticking is possible.

3—Double extra heavy construction; occupy minimum head room.

4—Sizes up to 20 inches.

GOLDEN-ANDERSON

Pat. Automatic Cushioned Steam Pressure Return Valves



Constant reduced pressure at all times.

Safe Operating Piston makes it impossible for high pressure to enter into low pressure service. Thoroughly cushioned—no hammering, chattering or sticking.

No auxiliary valves or small by-pass—

Double extra heavy through out—Practically indestructible.

Only one adjustment—on the outside.

Golden-Anderson Valve Specialty Co.
1306 Fulton Building Pittsburgh, Pa.

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"Seniority Status" *or* Production Basis?

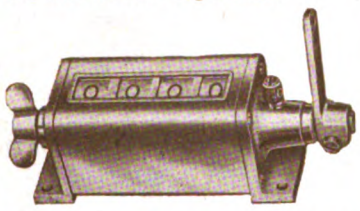
Are you paying some workmen what they're *assumed* to be worth to you, by virtue of seniority in employment?

Do you know what they're actually worth on a *production* basis—or whether some newer men are not deserving of the higher wage?

You have the answer when machines are equipped with—

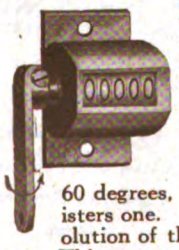
Veeder COUNTERS

You then see how each workman sizes up compared with the others; how he really ranks in competence and how he *ought* to rank in the wage scale.



The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list). Smaller counters at prices from $2.00 up.

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required in recording the output of many small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adapted to no end of counting purposes, simply by regulating the throw of the lever. Price, $2.00. (*Cut nearly half size.*) Small *Revolution* Counter, to record revolutions of shaft, also $2.



You can apply the "counter test" at all your machines where you'd like to appraise your workers. Send for the Veeder booklet and see just the counters suitable.

The Veeder Mfg. Co.,
63 Sargeant St., Hartford, Conn.

almost equally responsive to all vibration periods over the whole range of speech and music.

The electrical equipment is so arranged that another type of transmitter may be used when desired. It is not a "microphone" at all but what is generally known as a condenser transmitter. It contains no little cups of carbon granules which characterize the microphone although it has a vibrating steel diaphragm and makes use of air damping. It requires considerably more preliminary amplification than the microphone but it has certain characteristics which at



Already a landmark in the Walker Street section, the Telephone Building has taken on new skyline interest since the installation of its aerial for "WBAY," the new toll broadcasting station of the American Telephone & Telegraph Company.

times make its use desirable.

A glance at the circuit diagram will show how the electric waves generated in the microphone by the sound waves are led, first to the input amplifier and thence to the radio transmitter. The input amplifire contains three small tubes and one 50-watt tube and the transmitter uses two 250-watt tubes as oscillators and two others as modulators. All of these tubes employ the oxide coated filament which gives a very copious electron emission at a dull red heat. The system of modulation is of the Heising type and the general circuit arrangements are given in one of our accompanying illustrations.

To Executives who know the value of TIME—

Keep your business at your finger tips by being in *instant* communication with all departments.

Ask us to demonstrate the money-saving value of Callophone Service right in your plant, anywhere within a hundred miles of New York.

Hundreds of leading industries are now using it, and testify to its indispensability.

Write for details.

CALLOPHONE

CALLOPHONE COMPANY OF NEW YORK
Cor. Grand and Lafayette Streets
New York

G.P.&F. Service
Knowing How Since 81

A means towards lower production costs



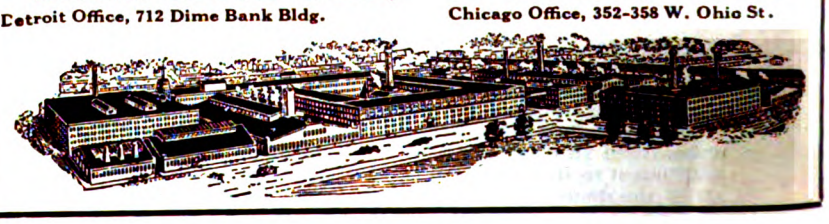
We can make your STAMPINGS and SHEET METAL PARTS in any quantity better and at less cost than they can be made in your own plant.

It has been a revelation to many manufacturers who *did not know* they could use STAMPINGS to advantage. It has displaced Castings, Forgings and Wooden Parts and in some cases entirely eliminated machining and fitting —a decided saving in itself.

Our organization has the experience of 41 years in this work. A 15-acre plant containing whole batteries of high speed specially equipped presses are at your service. They are adapted to a wide variety of work.

It will pay you to send blue prints or samples for estimates on Stampings, Forming, Drawing, Punching, Pressing and Spinning in Steel, Aluminum, Copper, Zinc, Brass or Tin.

Geuder, Paeschke & Frey Co.
1450-1750 St. Paul Avenue, Milwaukee, Wisconsin
Detroit Office, 712 Dime Bank Bldg. Chicago Office, 352-358 W. Ohio St.



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Sand—a Magic Substance

(*Continued from Page 19*)

closer together, but finding entrance into the pores. In this way the individual grains are united with the cement and the result is a very compact and well-nigh indestructible whole. In cases where the exclusion of moisture is desirable the harder siliceous sands are preferable.

In the manufacture of concrete it is important, where strength is desired, that the grains of sand should not be worn and rounded nor all of the same size, since smoothness of surface and regularity of size mitigate against adhesion. The usual method is to mix sands from various screenings, which causes the mass to dovetail together with the least possible number of voids.

The basis of all glass is sand, and glass besides serving as the medium for allowing sunlight to enter buildings is used quite extensively as a fire-proofing material. In the form of bricks it has also been tried out for construction purposes. A building, particularly a home, constructed almost entirely of glass would, of course, be an ideal structure from the standpoints of light and cleanliness. Also, being a most indifferent conductor, it would act as a protector of interiors against extremes of heat and cold. But unfortunately the glass brick is not only expensive to manufacture, but is very easily broken or chipped, two disadvantages which offset all its other desirable qualities. Cast glass tile, however, has been used with considerable success. The only trouble is that once the surface is scratched, it fractures easily, and in order to prevent this it is necessary to make the glass tile very thick.

In the manufacture of glass the molten mass is either blown, rolled or pressed; in the latter case it is poured into a mold. A very high grade of window glass, such as is manufactured in a natural gas tank furnace, is composed of a mixture of 100 pounds of sand, 39 pounds of salt cake (sulphate of soda) 30 pounds of crushed limestone, 2½ pounds of ground carbon, and 1 pound of arsenic.

The sand blast, first mentioned in this article as one of the many uses of sand, has an almost incredibly large number of uses in the manufacturing arts. It is used by silversmiths to create the delicate frosted designs on silverware. The article to be decorated is covered with a stencil or pattern of rubber or some other yielding material and then the sand blast is applied. The biting, corroding sand attacks the exposed parts of the silver vessel only, thus producing the desired design. Ground glass, which is used in cameras and for many other purposes, is produced in the same manner.

Sand for cleaning iron, steel, brass or other metal castings is invaluable. Where structural iron work is to be cleaned, preparatory to painting, nothing is so effective as the sand blast. The surface of the metal when scoured in this way presents a porous face for the paint to enter, and for this reason one coat of paint lasts a long time. The paint must be applied immediately after the sand blast is used, however, as the surface soon begins to scale, due to oxidation of the metal.

Nothing is so effectual for use in public filtration plants as sand. In fact, modern sanitary engineers would hardly be able to get along without it. It does the work of cleansing water of bacteria, filth and other alien matter much more effectively than anything yet discovered. In some cities pure water is obtained from streams which are often muddy or pulluted with sewage by drawing the water from wells sunk below the river bed. The sand of the river's bottom, which is often several feet deep acts as a filter, sifting out and holding fast all material dangerous to the health of the public. A natural filter of this sort is not, however, as satisfactory as one built under the direction of skilled sanitary engineers.

At Aspinwall, near Pittsburgh, one of the largest and most successful filtrations plants in the coutnry thoroughly cleans some 120,000,000 gallons of water daily. This is what is known as a "slow sand" filtration plant. There are more than fifty filter beds, in each of which are thirty inches of sand, and beneath this twelve inches of gravel and assorted screenings. This plant

Moving Ash With Measured Steam

Moving ash with measured steam is made possible by the new Green Engineering Company development "REMOTE CONTROL."

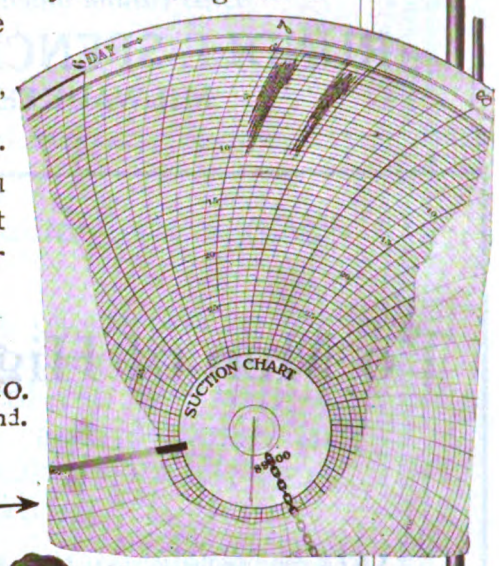
Remote control consists of an electrically operated steam valve which is controlled by the man hoeing the ash into the conveyor intake. This control can be fitted to old and new steam jet ash conveying systems alike.

Remote control is the answer to "excessive steam consumption." It makes the steam jet ash conveyor the cheapest as well as the cleanest and quickest method for the removal of ash from the boiler room.

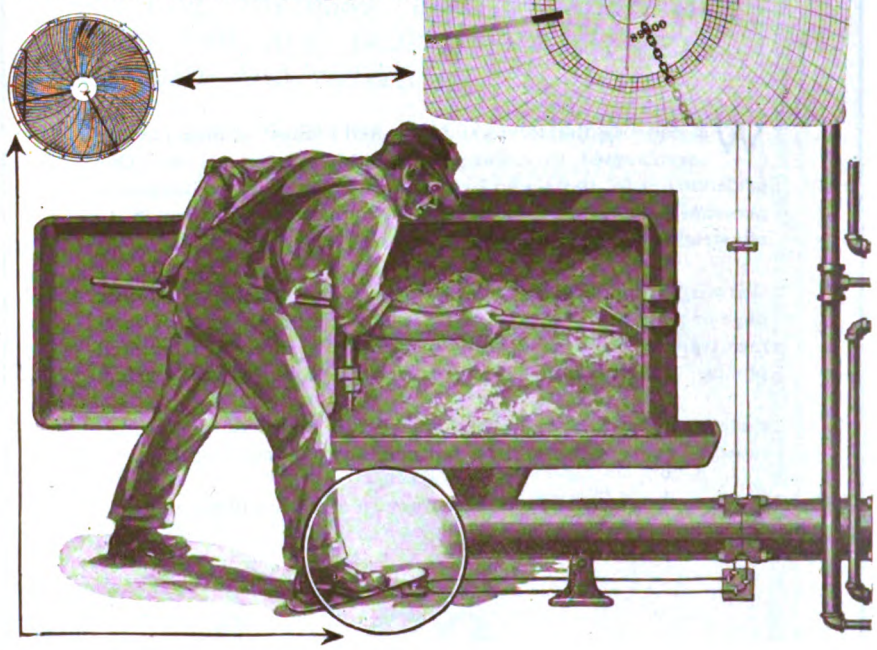
It makes it convenient for the operator to use steam only when he is actually hoeing ash into the system. It gives a tell tale record if he mis-operates.

"Remote Control" saves half the steam.

Let us show you more about steam jet ash removal under this new system.



GREEN ENGINEERING CO.
210 Kennedy Ave., East Chicago, Ind.



Green Chain Grates

ASH CONVEYORS
CAST-IRON HOPPERS
SEALFLEX ARCHES
PRESSURE WATERBACKS
FUEL RETARDERS

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"VERTICO-SLANT" DRINKING FOUNTAINS



Relieve fatigue and aid production

in your plant by furnishing continuous supply of clear pure water.



The R & S Metal Body Factory Coolers are built for long service and heavy duty containing 92 ft. heavy coil. Cork Insulation saves the ice—the water is chilled but does not come in contact with the ice. And the VERTICO-SLANT Stream is an absolute safe-guard against contamination.

Write today for prices.

"Lips cannot touch the nozzle"

RUNDLE-SPENCE MFG. CO.
MILWAUKEE, WIS.

To Men of High Standing

WE can use the services of a limited number of men who are accustomed to dealing with industrial executives. Our preference is for those who have had experience as production or personnel managers, as industrial engineers, as salesmen to ndustrial concerns, or in related lines.

Our work is more fully presented in an advertisement on another page of this issue. We conduct a well-rounded program of foremen training which has already made good in over five hundred pl ts. Its remarkable record of results is thoroughly convincing.

Only men of high standing and ability can represent us successfully. Their compensation is fair and may run into large figures.

If you are interested write at once in strict confidence to:

William H. Lough, President
Business Training Corporation
185 Madison Avenue, New York

cost about seven million dollars and has resulted in reducing the death rate at Pittsburgh from typhoid to a very low percentage.

In sewage disposal beds, sand acts as in water filtration plants. For this purpose, the sand of the sea dunes is declared by engineers to be the best. This must be selected with great care, however, inasmuch as it must be free from loam, clay or other inorganic impurities. Gravel is first laid over the under drains of the sewage beds. Upon this is placed the sand. The purpose of the gravel is to prevent the sand from working down into the drainage pipes, through the joints. For such a purpose as this, sand has no intrisic qualities of its own. It acts mechanically, as a strainer. In addition to this, however, it also offers a harboring place for nitrifying bacteria, that is, the bacteria which convert the ammonia of the decomposing vegetable or animal matter into nitrates. The sand also holds oxygen for these bacteria, though those that burrow deep beneath the surface, far from the sunlight and air, need but very little.

Deposits of sand suitable for building purposes vary in size, just as do deposits of stone, but in general they are of wide extent and a field that is considered worth working for commercial purposes will cover fifty acres or more. The depth of a sand and gravel deposit, for a pure sand deposit is seldom found, may be anywhere from forty to a hundred feet. When operations are first started a separating mill and elevator is built at a certain point. From there a railroad extends to the pits, its progress following that of the steam shovels which dig up the sand and load it directly into open freight cars. The loaded cars carry the sand and gravel to a dump located near the mill, from where it is conveyed by a belt conveyor to the top of the mill. The belt conveyor shown in the illustration is 350 feet long and the top of the mill 90 feet high.

At the top of the mill are a number of cylindrical steel screens of varying degrees of fineness. The sand and gravel enter these screens direct from the belt conveyor. As the steel cylinders revolve, streams of

(Continued on Page 53)



"AS PER PHOTOSTAT Copy HEREWITH"

This phrase is coming into general use in business offices, because each day another company realizes that the PHOTOSTAT way is, for many purposes, the quickest, the most economical and an error proof method of copying. The PHOTOSTAT method costs cents where other methods cost dollars, produces at a possible speed of one copy per minute, and

The PHOTOSTAT makes no mistakes. It makes photographic facsimiles.

When it is necessary to show valuable documents in some business transaction and you do not wish to send the originals out of the office. PHOTOSTAT copies are equally acceptable as they are legal evidence in court.

But the uses for the PHOTOSTAT do not end in the office. The PHOTOSTAT is also used in the production department. Here it eliminates the necessity of making tracings, as it copies direct from blueprints, pencil sketches, ink drawings or even from the original object, within certain limits of size.

It is the numerous and valuable uses of the PHOTOSTAT which in many cases pay for the installation in less than six months.

Write or telephone our nearest office.

PHOTOSTAT CORPORATION
295 STATE ST., ROCHESTER, N. Y.

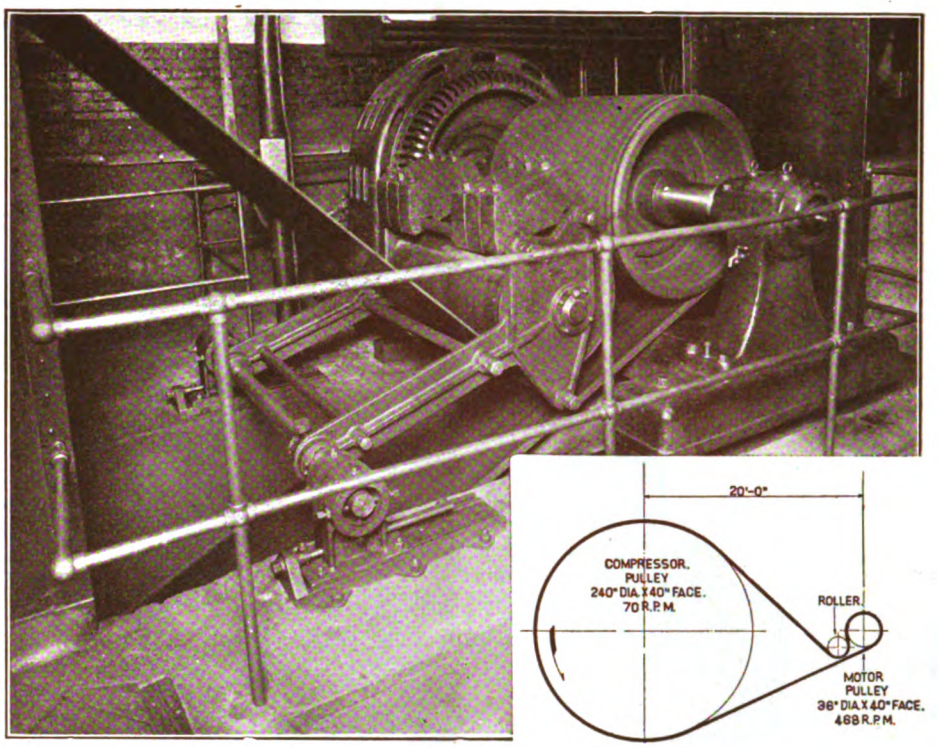
88 Broad St., Boston
123 W. Madison St., Chicago
209 Leader Bldg., Cleveland
7 Dey St., New York City
510 No. American Bldg., Philadelphia
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The Korap*Lenix Drive



500 H. P. Motor Driven Ammonia Compressor, Motor Pulley 36" Dia., 40" Face, 468 R. P. M. Compressor Pulley 240" Dia., 40" Face, 70 R. P. M. Double Leather Belt, 39" Wide, 7/16" Thick.

In changing from steam to electric drive, the owners of this 500 H. P. motor driven ammonia compressor were confronted with the problem of installing a belt drive in the space occupied by the old steam engine. The floor space was limited and an ordinary open belt drive would not give sufficient arc of contact of the belt on the motor pulley to transmit the load.

The KORAP LENIX solved the problem.

Note the large arc of contact of the belt on the motor pulley obtained with the KORAP LENIX, insuring the transmission of the maximum load without belt slippage.

There is no flapping of the belt, as the KORAP LENIX automatically follows the peaks and valleys of the load with a corresponding increase and decrease in the arc of belt and pulley contact, synchronous with the variations.

The proper tension in the slack side of the belt is maintained constantly by the KORAP LENIX irrespective of atmospheric and temperature changes.

Bearing pressure is minimized, saving in bearing friction, lubrication and renewal of bearings.

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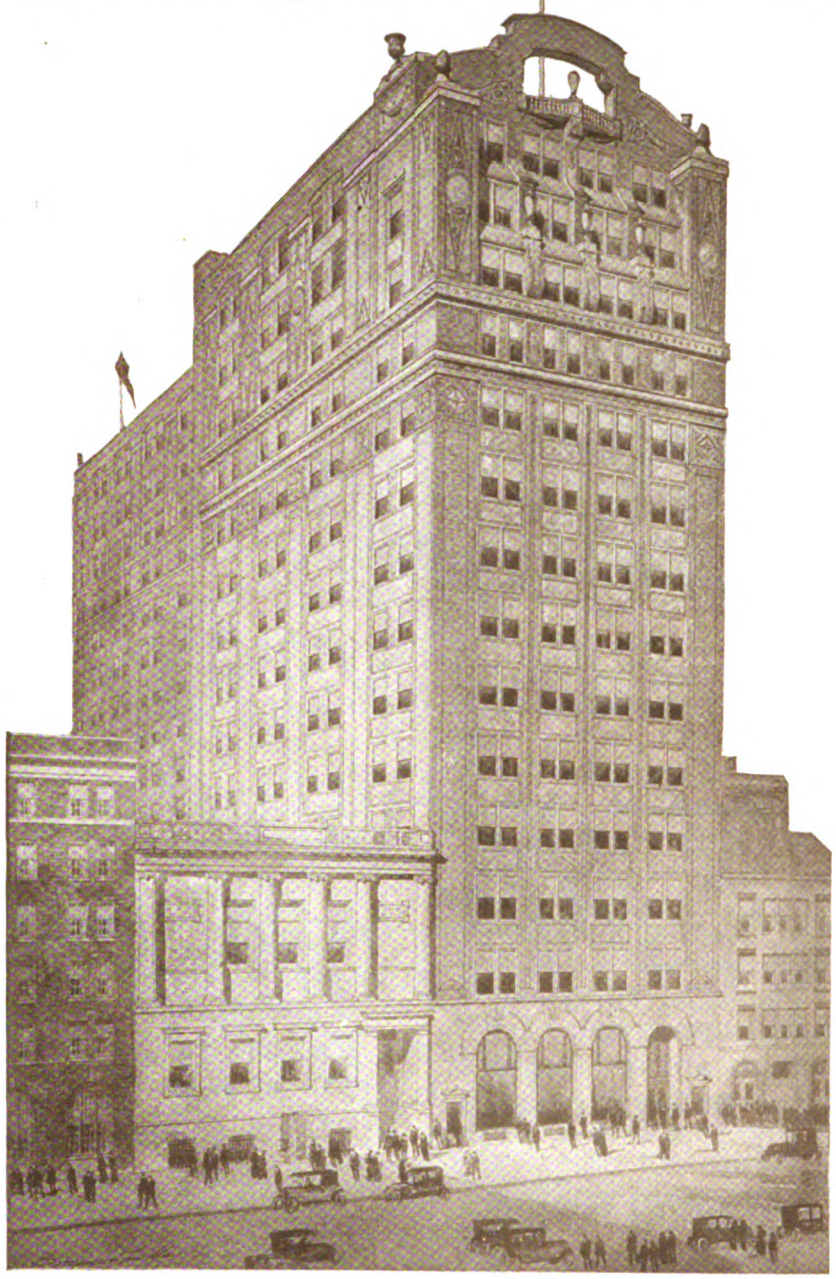
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(Continued from Page 50)

water are directed against them and the sand is washed out and down wooden chutes into the storage elevator, the gravel, of course, remaining inside the screens, which are emptied from time to time. The streams of water also have the effect of washing away any dirt that might be in the sand, so that the latter reaches the storage bins perfectly clean. All that is necessary then is to give it time to dry out, after which it is drawn out of the storage bins into freight cars, as needed, very much in the same manner that grain is unloaded from a grain elevator.

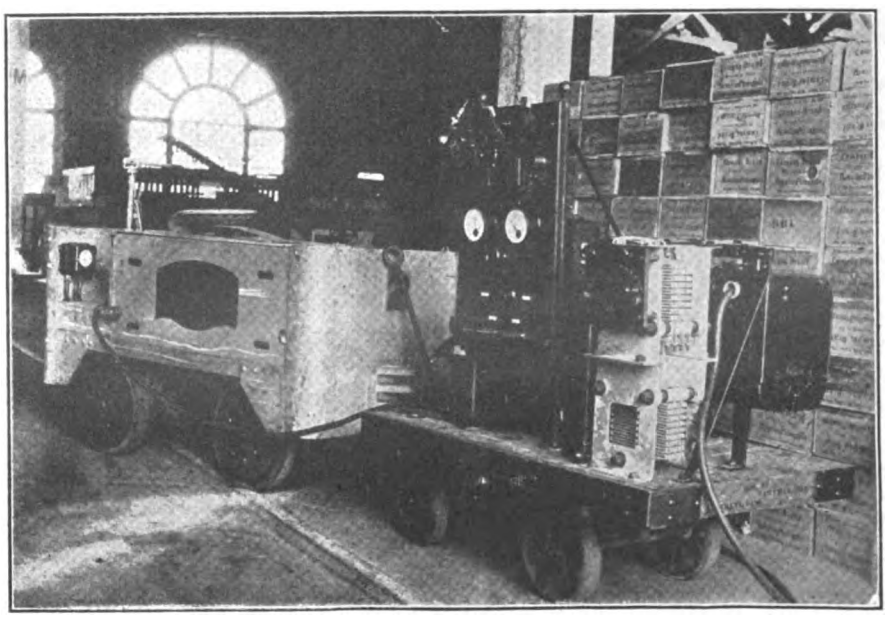
Portable Charging Equipment for Electrically Operated Tractors

THE California State Harbor Commission is now operating two specially designed portable charging outfits, which consist of special battery-charging equipment mounted on a four wheel truck, used in charging the various electrically operated tractors owned by the Harbor Board. The charging equipment was made portable so that it could be towed from pier to pier for use at the point where the electric tractor is being used. This portable feature is also of great value, because, since it enables the charging equipment always to be handy for charging the tractor at the point where the tractor is being used, it saves time and current in going to and from the permanent charging station. Inasmuch as the charging equipments is fully automatic in every particular all that is necessary for placing the equipment in charge is simply the connection of the charging plug to the battery and the closing of the motor breaker.

The charging rate is adjusted once and for all and no further adjustment is necessary. The design of the machine automatically maintains a constant charging rate, which is a prime essential in getting the best results from batteries.

The illustration on this page shows the portable battery-charging outfit connected with one of the electric tractors for recharging. After the charging process is started the operator does not have to give it any attention whatever. When the battery finally becomes fully charged it is automatically disconnected from the generator, the motor generator-set is automatically disconnected from the line and the whole equipment is at a standstill. In the event that power to the motor generator should fail, the battery is automatically disconnected from the generator, and the motor-generator set comes to a stop.

Upon the return of current to the motor the motor-generator-set automatically starts up and the battery is automatically connected back on to the charge. This may occur once, or several times, and still the apparatus functions the same. Finally, when the battery be-



Portable charging outfit, charging batteries on electric tractors "on the job."

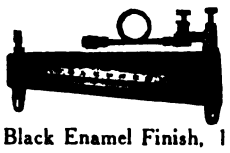
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comes fully charged it is automatically disconnected from the generator and the motor generator set is disconnected from the line.

The entire equipment is fully protected against overloads. The motor is protected against overload and single phasing by means of oil circuit breaker equipped with dash-pot time element overload coils; the generator is protected against overload by means of single-pole carbon circuit breaker.

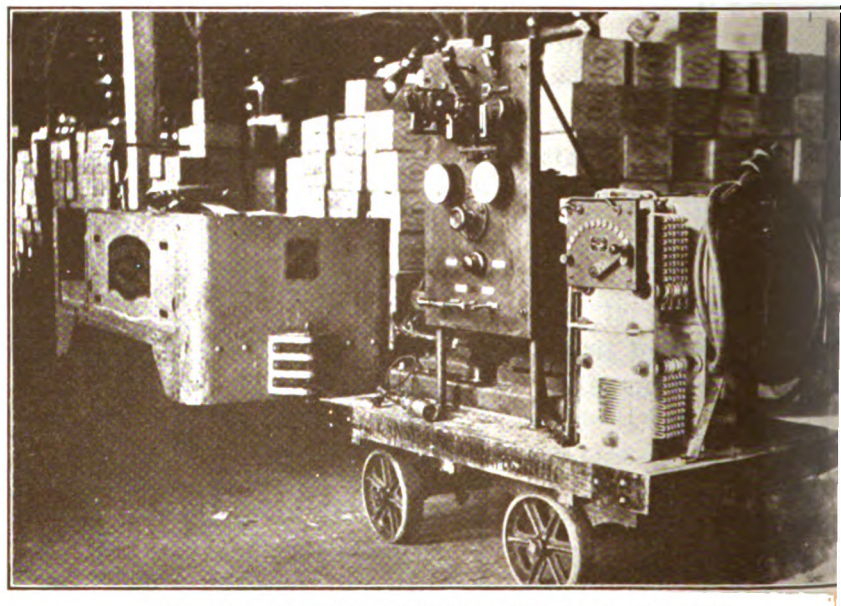
The charging equipment is mounted on two rubber-tired trucks on which special provision has been made for towing by a tractor to whatever docks it is desired to use the charging equipment.

One of the charging equipments has an additional feature, which is the ability to totally discharge the batteries of any tractor when occasion demands.

Batteries can be fully charged on any electric tractor in from 5 to 6 hours. Thus, two batteries can very easily be charged with one of the portable charging equipments during a 24 hour period, allowing 8 or more hours for service of the tractor.

The electric tractor, which tows the charging unit, is owned by the Harbor board. It has a ten ton trailer capacity, and a speed of 5 miles per hour. This tractor is provided with three trailers having a capacity of 6,000 lbs. each. Each trailer is equipped with a Y-shaped hook coupling of forged steel, fitted with elongated eyes so that it will rest in a vertical position when not in use. A catch is provided to prevent uncoupling when going down an incline.

The equipment is used by various concerns along the water front who do not have sufficient business to warrant the purchase of their own equipment. The Harbor Board makes a schedule and furnishes the tractor and trailers and operator and charges the users a stated hourly rate for their use.



Complete Portable charging outfit being towed to new location.

Mahogany—King of the Jungle

(Continued from Page 24)

he plans to "fell" the tree. Once the thick undergrowth is chopped away the cutter finds his tree so buttressed with great roots that he must oftimes build a scaffold from eight to twelve feet high about the body of the tree and cut from this height. This means the loss of much valuable wood, but it is the only way in which the Indian with his primitive tools can accomplish his purpose.

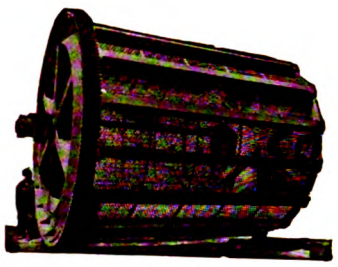
Once down, the king of the south woods is stripped of his great branches and the cutter begins the tedious, laborious process of hewing the great round log into a squared stick. This entails further loss of valuable wood, many times 20 to 30% of the log being thus sacrificed. If a certain cut in the log be 20 feet in length, the squared stick is only the size of log that may be cut from the small end of the round *troza*.

When the log has been fina

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PUZZLING Reduction Problems Occur in Almost Every Industry

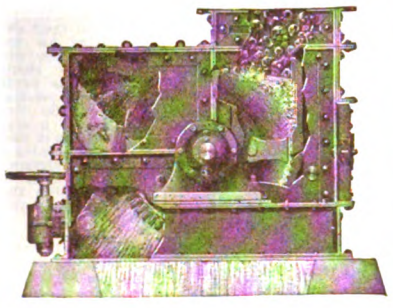
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hewn into a squared stick, the exposed sides are carefully covered with slabs to protect it from the alternate effects of rain and sun. The cutter then hews his way through the tangled growth to another tree.

Caoba Leaves the Woods

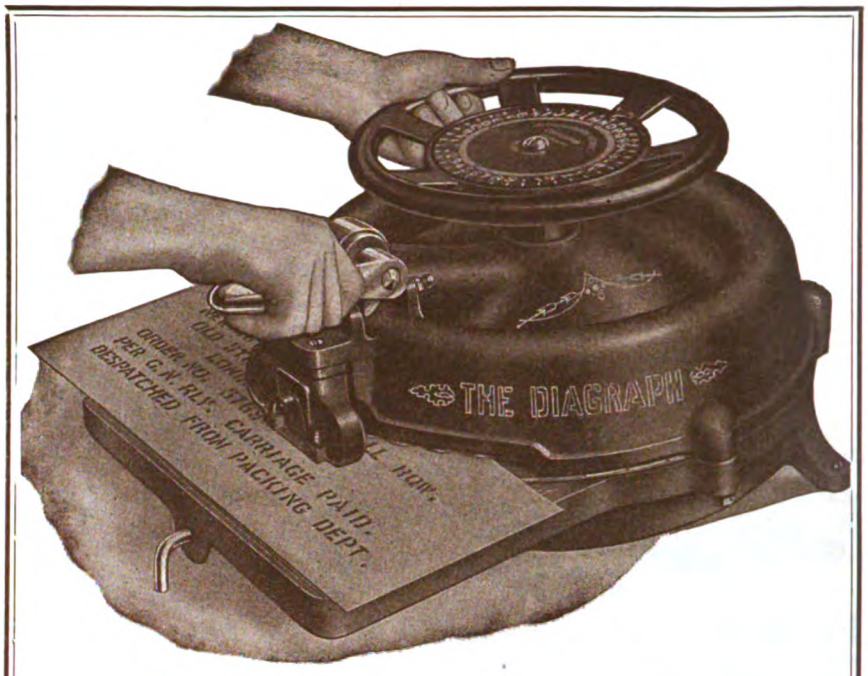
When the rainy season has passed and the heat has, in a measure, dried out the dank, humid woods, come long strings of *bueyes,* or oxen, ten to fifteen yoke, dragging a low, crude cart with which to "snake" the seasoned mahogany *troza* from its century-old home in the forest, out through the narrow *callejones,* to the main road that has been cut into the jungle. Here they are left by the side of the way to await the coming of the *trinquivales.*

La casa grande, or the owners' home, always on the bank of one of the many navigable streams of this south-Mexican country, is probably ten to twenty miles from the spot where this tree grew. It is here, in the river, in front of the *hacienda,* that the logs are finally dumped and formed into a raft. During the rainy season the *trinquivales* (enormous, home-made, two-wheeled carts), are repaired or new ones are built, so that with the stopping of the rains the hauling begins.

Life in a Mahogany Camp

At midnight the *mayordomo* rings the big plantation bell. Presently gleams of light show through the sides of the wattle, palm-thatched huts of the laborers, grouped about the main house. It is time to start for the woods. While their women folk prepare a breakfast of *posole,* (uncooked cornmeal mixed with water into a gruel), fried bananas and *frijoles* (Mexican beans), the men hurry up to *la casa* where the *mayordomo* waits to measure out to each of them a little mahogany cup full of *aguardiente* (Mexican cane rum).

Thus fortified, the *peon* eats a scanty breakfast, carries with him a little sack of *posole* to last him the next twelve hours, and hurries off to the corral, the mules and the *trinquivales.* By one o'clock the queer cavalcade sets forth, the *capataz* leading the way on his favorite riding mule, the others following, seven mules to the cart and the drivers generally lifting



READ "The Freight That Failed"

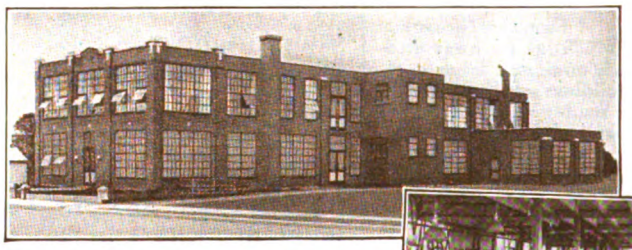
By Forrest Crissey

Every business man should read this illuminating article in the May 27th issue of The Saturday Evening Post. Mr. Crissey, in discussing the $100,000,000 annual freight claim losses, states that the use of stencils for addressing is a highly effective means of loss prevention. Read Mr. Crissey's article—then buy a Diagraph. Free trial in your own shipping room.

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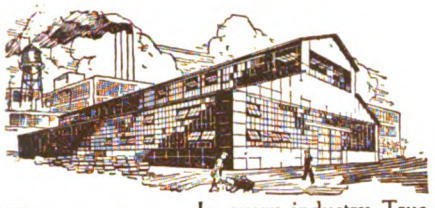
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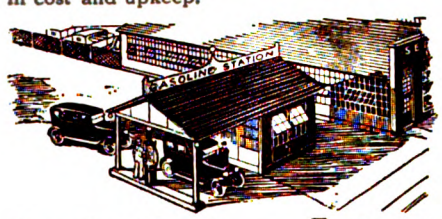
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their respective voices in a falsetto chorus or many times following the leadership of some local minstrel who improvises a word-story to some popular tune:

"La Cucaracha—La Cucaracha —ya no quiere caminar—"Porque le falta—porque no tiene—. marahuæna que chupar!"

Five hours dragging through a jungle trail shut in by a darkness denser than the jungle itself, until at day-break the caravan reaches the *trozas* that have been dragged out by the ox teams. Two hours during which these unwieldy blocks of timber are securely loaded by these simple workmen, using the most primitive methods, and then *posole* and a little more rum, and the long drag back to the *casa grande* and the river begins. It is one or two o'clock in the afternoon before the *trinquivales* are finally backed down to the bank of the river and the mahogany *trozas* slid into the water.

By the end of the dry season enough logs have been hauled in from the woods to make up a great raft. With the last log in, the individual *trozas* in the river are skillfully lashed into a long, narrow raft, held together by the tough vines that may have grown from their very limbs. *Caoba* is ready for its long trip to the sea.

The Mahogany Raftsman

The *peon* raftsmen, who are to take the logs to Laguna, build little huts on board and thatch them with palm leaves. Into these they move their families, chickens, always a pig or two—secured with a leather thong about its neck—and with scanty supplies of corn and beans, they set forth on their two or three months' voyage—a *peon* and his family piloting a $100,000 raft to market!

Above the rapids the unwieldy craft must be moored, carefully broken up, and, log by log, taken through to be reassembled below the falls. While this is going on, the homes and the family of the raftsmen have been transferred to dry land—only it is never dry at this season of the year.

At the mouth of the river the raft is met by a small tug which tows it across twenty-six miles of bay into Laguna harbor. Since this is the season when

(*Continued on Page 58*)

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One of the 65 Thousand

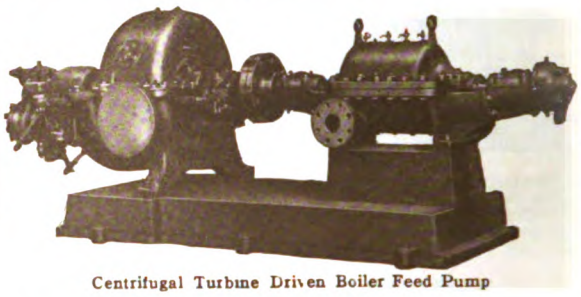
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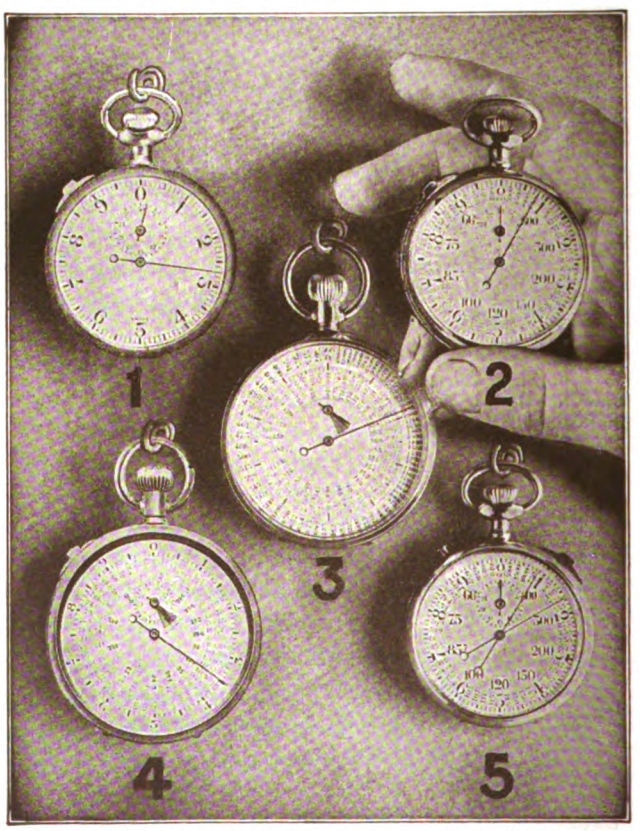
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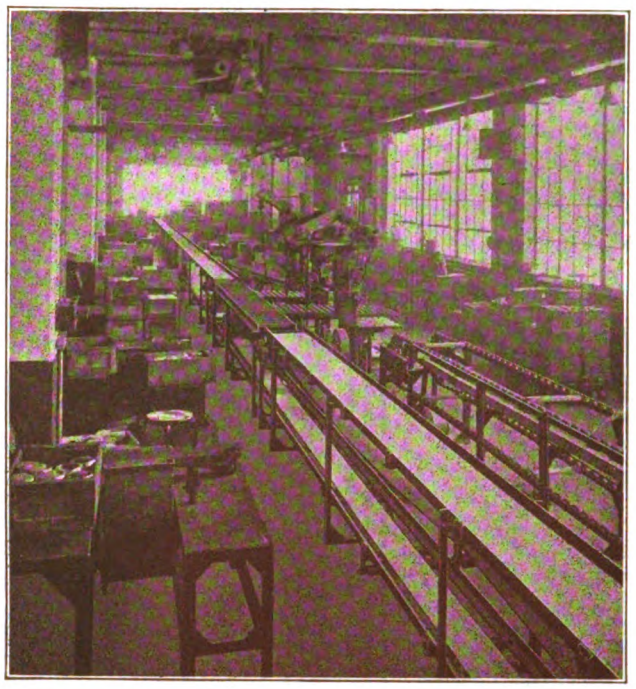
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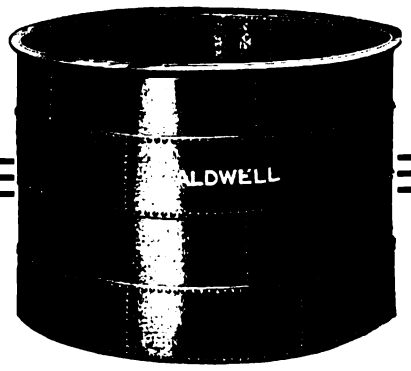
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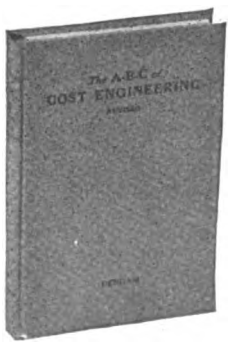
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is to stop the hidden losses. Every dollar of loss comes out of profits. The unseen, but preventable leaks in the average well-managed business (without a Denham System) are usually more in amount than the net profits.

Denham Systems Reveal Hidden Leaks

in both the making and selling effort. Stoppage of the greater part of these, losses will easily double the profits, without increased investment, or additional expenditure of effort and money, such as would be required for doubling production.



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THE DENHAM COSTFINDING CO.
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437 Sloan Building **CLEVELAND**

(Continued from Page 56)

violent "northers" may blow up without an hour's notice, the "tow" is often lost, the raft broken up, and the result of a whole year's work is frequently scattered up and down the beaches for fifty miles.

Log Pirates

Anticipating this, each log is marked with the private brand of its owner, but certain unscrupulous natives—mahogany pirates—carry on a profitable business in the recovering and remarking of these pieces of timber.

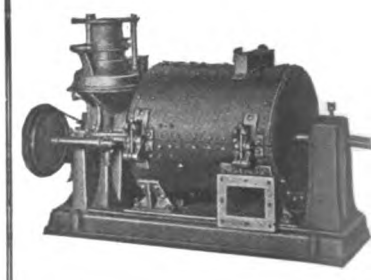
Once in Carmen and alongside ship, more hewing and cutting and then inspection by the Argus-eyed company inspector, who buys the logs always far below actual value and classifies them so that most of the first class sticks become second or third class quality. Then a chain, a winch, a few snorts of a "donkey" engine and *caoba,* King of the Tropical Woods, is stowed away in the smelly hold of a tramp steamer to be unloaded on the docks in New York or Liverpool.

A mahogany log, worth $2 on the stump, $30 in Laguna, may prove to be so highly figured that when it reaches the mill it eventually brings $2,000 to $5,000.

Solid Mahogany Houses

Solid mahognay furniture is a myth. No good mahogany furniture is "solid." The top of a desk or table is "built up," generally with layers of less valuable wood, upon which a piece of beautiful mahogany veneer, perhaps only 1/28 of an inch in thickness, is superimposed. This insures that it will not warp and gives all the beauty that "solid" mahogany could offer. Only in the home of *caoba,* down in the Great South Woods itself, is "solid" mahogany used. There houses, corrals, *cayucos,* (dug-out canoes) even fences are built of it because it is the easiest wood to saw out with their primitive board-making process. To secure a mahogany plank, a log is placed horizontally on a trestle. One man stands above the log, another on the ground beneath it and an old-fashioned crosscut saw whines its uneven way length-wise through the log, cutting out a few rough planks to be used as flooring and siding for the new *bodega.*

Pulverized Coal



The Aero Unit System

of Pulverized Coal again demonstrates, as in other work of human endeavor, how an original idea at first worked out by complicated and costly methods is finally simplified and perfected until it becomes a part of our every day existence.

The Unit System reduces the equipment and therefore the cost to a minimum by placing the Aero Pulverizer at the furnace where the coal is fed to the machine undried and is exhausted therefrom directly into the furnace. There are no dryers, no storage or long lines of transportation for the powdered coal, thus eliminating the hazard of fire or explosion.

Each Aero Pulverizer is designed as a complete powdered fuel unit for one furnace. They are built in standard sizes ranging from 600 lbs. to 5000 lbs. of coal per hour.

Bulletin Sent on Request

AERO PULVERIZER COMPANY
165 Broadway
New York

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Tabasco Mahogany is disap-earing. For a hundred years nd more the wasteful lumber-g process as above described as been going on. Most of the ood wood within reach of nav-able water has been cut out nd only limited areas, far re-oved from transportation, re-main untouched. Unless some effort is made to re-forest these jungles with this magnificent tree, "true" mahogany will only be known as it is viewed in antique furniture, while Afri-can, Philipine, Australian and other substitute mahoganies will have taken its place.

Harnessed Mountain Energy Harvesting the Mountain's Crop

(Continued from Page 11)

rst test run on May 20, when "coming out" party was aged. Since that time the ow of logs from the great for-ts twenty-eight miles distant railroad, the buzz of the aws and the hum of the great otors has increased. Every g of the plant has proved its ility to perform its portion of e work.

From trees to be finished mber that goes into homes nd factories is not such a long ail, once the machinery is in otion. But when those trees re located twenty to sixty iles distant in a rough moun-in country, foresight and the dicious expenditure of a lot money are required to com-lete the plant that will turn t the finished product at an pense that will leave a profit.

Realizing this fact the Hutch-son Lumber Company took lvantage of those resources at and. Agreement was reached ith the Western Pacific Rail-oad Company whereby for ght miles logs are transport-l over their tracks. The estern Pacific also built two iles of the logging road, from idwell to Bidwell Bar. From is point the Hutchinson Lum-r Company main line has now en extended into the moun-ins to the point where logging oads lead off into the timber.

The next move of the Com-any officials was to secure the eapest possible power. This roved to be electricity, pro-uced by the Great Western ower Company at their Las lumas plant some fourteen iles distant from the scene of gging operations and a simi-r distance from the mill at roville. High tension trans-ission lines were constructed provide the power.

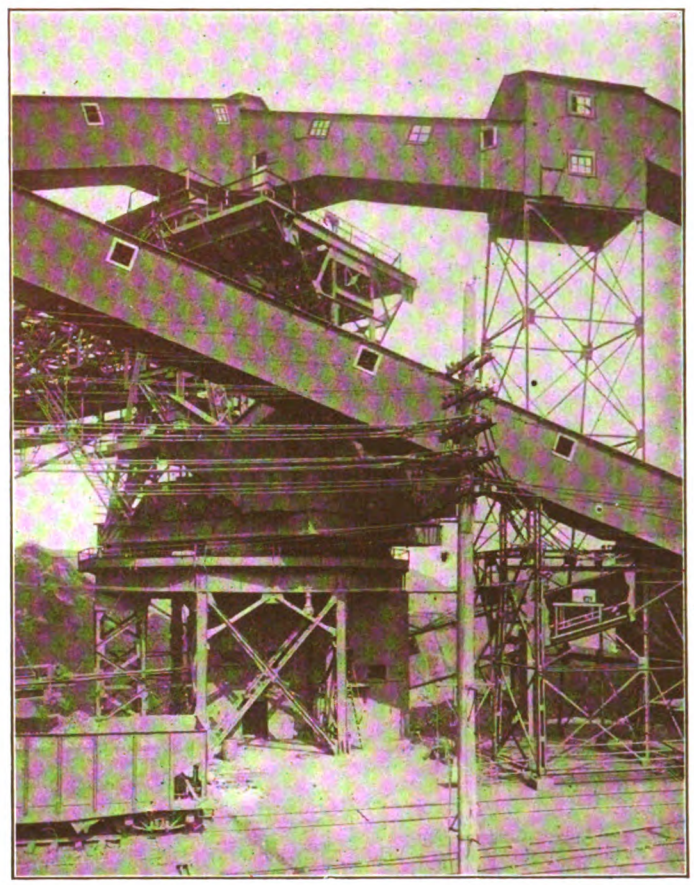
In building the logging road, at connects the Company's 40,000 acre timber holdings with their mill at Oroville, the rumble of blasting powder and the exhaust and whistle of the steam shovel awakened an area that only a short hundred years ago knew the Indians as its sole inhabitants. Its first real experience with the white men came with the gold rush in 1848 and '49, when red-shirted miners fought their way through the dense timber to reclaim the golden metal from the gravel of the waterways. A quarter of a mile distant from the present railroad of the Hutchinson Lumber Company the Indians of the old Maidu tribe still meet once a year to perform their weird ceremonial for the dead. Amid the trees that they could not use but which the white man turns to his advantage, they congregated to weep mournfully for their departed, while chanting sorrowfully and with great tears streaming down their cheeks.

A feature of the railroad is the wooden trestle spanning the South Fork of Feather River, which, by means of hinged knee-bent construction, gives a clear water span of 120 feet, supporting the stringers of the trestle on 25-foot centers. The entire railroad passes through country whose beauty is not excelled by that of any other railroad in the country. It is standard-guage, containing 75-pound rail on the light grades and 85-pound rail on the heavy grades. It has a maximum grade of 5 per cent on tangents, all curves being compensated, and has an average grade of 3 per cent. The maximum curvature is 28 degrees.

A 70-ton and a 90-ton Shay locomotive furnish the tractive power, standard Western Pa-

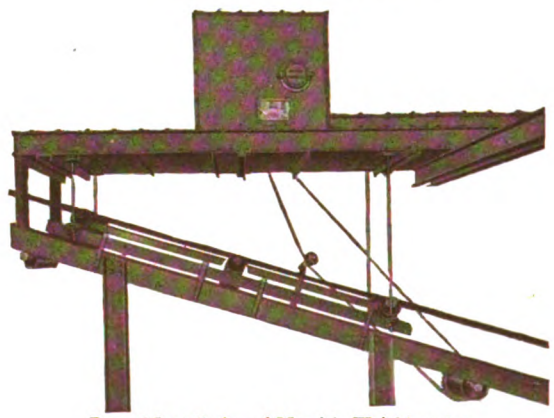
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cific flatcars being used for the transportation of the logs. These cars are all equiped with both straight and automatic air brakes and the latest improved type of logging bunks.

The forest consists of California White Pine and Sugar Pine. The largest of these trees reach a trunk diameter of from six to eight feet. To bring these great logs to the loading piles at the railroad, five electric donkeys are used. The logs are dragged to the railroad by cables. Each of these donkeys (which take the place of the old steam donkey) are operated by a 300 H. P. electric motor.

The logging equipment includes the five large electric compound-geared two-speed yarders and two electric two-speed loaders, having as auxiliary units one 30-ton American Locomotive crane for loading purposes and one 10-ton Holt tractor, and one set of Reliance high wheels for auxiliary skidding purposes. The electric yarders are of the most powerful design and have the highest line speeds of any logging machinery found on the Pacific Coast.

Arriving by rail at the mill the logs are dumped into a mill pond eight hundred feet in length by four hundred feet in width and with an average depth of eight feet. This pond is kept filled from a well, water from which is pumped by an electric motor at the rate of 1000 gallons per minute. The same well fills a 100,000 gallon tank that provides water for the extensive fire fighting system installed throughout the mill, dry sheds, planing mill, box factory and yards.

All machines in the 305 by 109 foot sawmill, with the exception of the skid lifts, log loaders and kickers, are operated by individual electric motors of general Electric make. Two 413 horse-power Sterling type boilers furnish the steam required, including that used in the dry kilns.

The timbers are sawed into lumber by three Filer and Stowell band mills including one eight foot and two nine foot mills. These mills are capable of sawing 75,000 board feet during each shift. With two shifts operating to capacity the mill will produce approximately 450,000 board feet of lumber daily.

With each machine in the m equipped with an individ motor and with push butto handy to each operator, t man in charge has comple control of the machine that operates at all times.

The box factory is 80 f wide by 197 feet long, and w not yet completed, will be mo ern in every detail, and w have a capacity of appro mately 80,000 board feet p day.

The dry shed, which is n under construction, but completed, will be 800 feet lo by 75 feet wide and will spanned by a traveling cra which operates over its ent length.

The lumber which goes to dry kiln passes over an au matic electric stacker from green sorting shed and, af coming out of the kiln, pas over an automatic unstac and dry sorting chain.

The green sorting shed, sorting shed, green stor yard, dry shed, planing and box factory are all conn ed by a mono-rail system.

Probably more spectac than any other portion of operations, with the excep of the electric logging donk is the electric mono-rail sys From the 540 foot green s ing shed the lumber is arran in stacks beneath the track which the overhead, electric operated mono-rail car r The mono-rail operator br his car to a stop above the s of lumber. Two sets of g fingers are dropped and ho beneath the stack of lum raised about twenty-five forty feet in air and the e stack of lumber is carried ily to its location in the ya

A transfer switch in mono-rail system permits mono-rail operator to carry stack of lumber to any des location in the yards. Arri in the yards, the great fing with their load of lumber, dropped down, unhooked, the lumber is in place. same system is used in loa the lumber on to cars for s ment.

In all of the operations at mill site the plant is so structed and arranged that three men will need to w without a roof to protect t from summer sun or wi rain.

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Receiving to Shipping

all through the plant—in every department—Cleveland Tramrails will greatly reduce the time, labor, and cost of handling your products.

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During the past four years, the Business Training Corporation has conducted not less than 80 per cent of all the training for foremen carried on in the United States. This record is in itself a sufficient guarantee that our training course in Modern Production Methods is sound and practical. It appeals strongly to the foremen themselves. The meetings are conducted by members of an experienced lecture staff. The expense is moderate.

To any plant manager or other executive officer we will gladly send on request a descriptive booklet called "Making Better Foremen." It will bring you worth while suggestions for strengthening the stability and profits of your business. Write for your copy—sent without charge or obligation—today.

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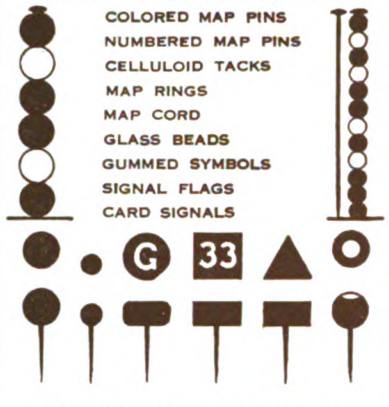
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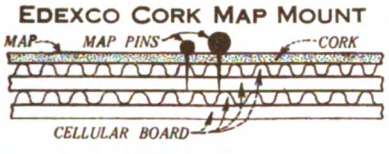
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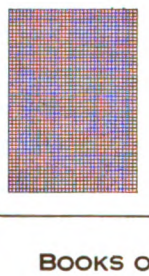
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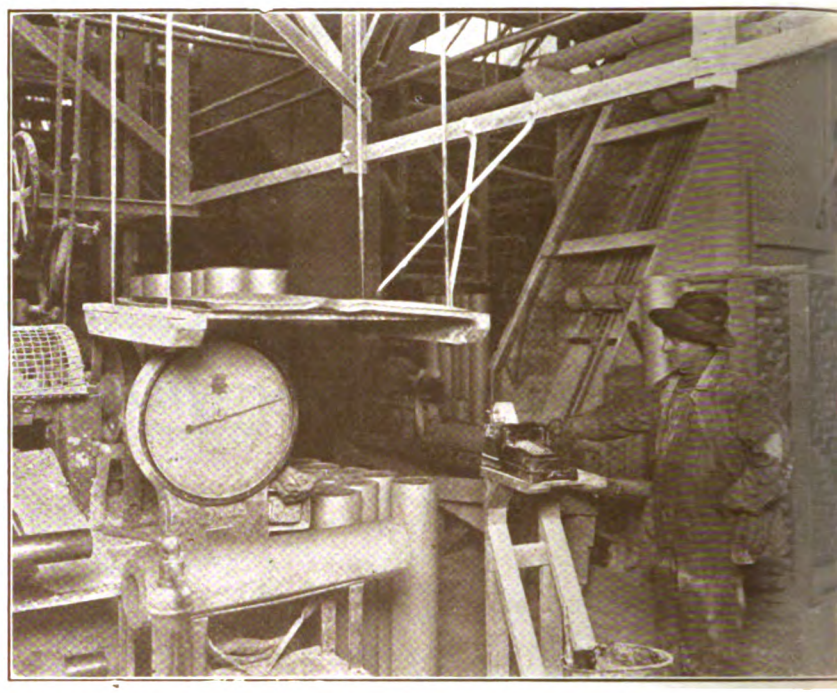
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Large Rolls of Paper Transported by One-Man Crane



THE accompanying illustration shows a one-man crane of special design employed in handling large rolls of paper and felt to and from the storage warehouse of the Paraffine Companies Inc., of San Francisco.

The crane runs on a series of I beams bolted to the roof trusses, thereby enabling the operator to deposit or pick up a roll at any point in the warehouse.

Two tracks extend across the end of the warehouse, over which a second crane operates; by means of which the one-ma crane can be transferred fro one I beam to another. Bot cranes are controlled by th operator, who rides on a sea attached to the crane that pick up the rolls. The crane is pro vided with a pair of heav jaws which engage the core o the roll as shown in the photo These jaws are opened an closed by jaws are opened an the operator's right hand. A soon as the crane operato lowers a roll to the floor, he re leases the jaws from the cor by manipulating this lever.



The telephone system illustrated above is in use in several large automobile factories. It differs from other intercommunicating systems in that depressing of the key establishes the circu without requiring action at the oth end. The man called does not have t stop work in order to answer.

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"The Foreman is the most vital link in Production"—A leading official of the DuPont Co.

Attack Production Costs Thru Your Foremen

The Foreman is the man who has to handle the *human element* in production—that most sensitive and difficult of all industrial elements. Upon his ability to handle men depends the loyalty and efficiency of the workers. If the Foreman is properly trained in leadership he can inspire the men in the ranks with enthusiasm and loyalty.

In addition to dealing directly with Labor, the average Foreman, if he is to keep pace with the requirements of his position, has to do an amount of work and discharge a volume of responsibilities big enough to demand the best energies of a really able man. If the Foreman knows his business as he should, if he is intelligently trained in the handling of jobs and in planning and production, he can accomplish more in efficient and economic production than any other man in the plant.

Industry is just awakening to the need of better Formanship and production methods. Speaking of this, a high and able official of the DuPont Company says:

"Management is almost universally to blame for the fact that it has not shown the foreman himself how big his job is. As most foremen are picked workers who have been promoted from the ranks, it is natural that they should be unfamiliar with many of the executive problems with which they must deal in their supervisory capacity. This is the big task of today—to supply that education."

Train Your Foremen Under LaSalle's Group Plan

LaSalle Extension University has organized the brains and experience of hundreds of industrial experts and thousands of Foremen into a practical plan of training in "Modern Foremanship and Production Methods." In fact, no less than five thousand Foremen have contributed their experience to this training. They have joined with experts and specialists to give American industry and its Foremen the result of years of study and practical shop experience. The result is a "practical-experience" course covering thoroly all phases of Formanship such as Handling Men; Developing Morale; Handling Jobs; Planning and Production; Cost Control in the Shop; Routing; Scheduling; Inspection, etc.

Mr. Hugo Diemer, M. E. In Charge

Mr. Hugo Diemer is the director in chief of this training. He has been engaged by the University to give his entire time to the direction of this work. During his career Mr. Diemer has had charge of production at the Goodman Manufacturing Co., Chicago, has been superintendent of the National Motor Vehicle Company of Indianapolis, and Head of the Industrial Engineering Department, Pennsylvania State College. During the war he was Commanding Officer at the U. S. Cartridge Company of Lowell and on the staff of the Commanding Officer at the Bethlehem Steel Works. For a year and a half he also was Personnel Superintendent of the Winchester Repeating Arms Company.

Associated with Mr. Diemer are Messrs. Meyer and Daniel Bloomfield, the noted authorities on industrial relations. Mr. Meyer Bloomfield was formerly director of the Harvard University Vocational Bureau, head of the Industrial Service Department of the U. S. Shipping Board Emergency Fleet Corporation, and Special Commissioner to Porto Rico for the War Department.

The LaSalle Foremanship Council



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The LaSalle Problem Method

There is no better way to learn than by actually doing. That is the basic principle of the LaSalle Problem Method used thruout our company--group training plan. The members are not only brot in contact with real problems of foremanship and production within the plant, but are shown how to apply principles and plant practice to their solution. The LaSalle group plan of foremanship training is a quick and effective way of increasing production, getting better coordination of effort, building loyalty and morale in the organization, and of making effective policies of the management.

LaSalle training in Modern Foremanship and production Methods affords an opportunity for the management of any industry to secure, under able and efficient supervision, group training within the plant for the foremen, shop executives—the men supervising production.

Increased production of 20% per man thru proper training and leadership on the part of the foremen has not been difficult of accomplishment. How much of a saving would such a result alone mean in your monthly payroll?

We invite inquiry from plant officials, production managers and executives. Let us explain to you in detail just how the LaSalle Company-Group plan of training in Modern Foremanship and Production methods can be installed in your plant. In making request for further information you place yourself under no obligation. Use the coupon—mail it now.

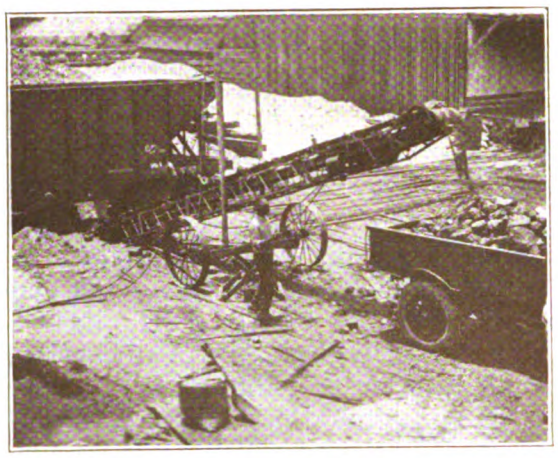
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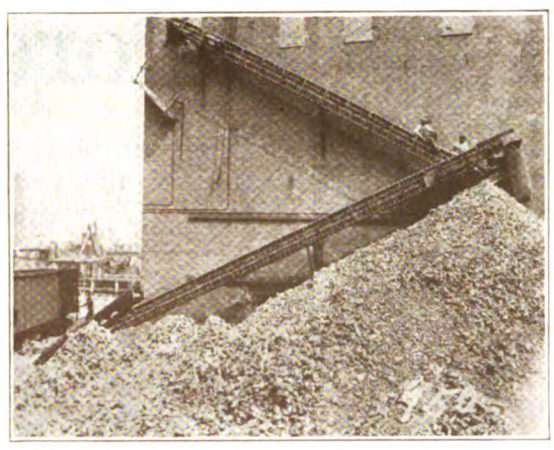
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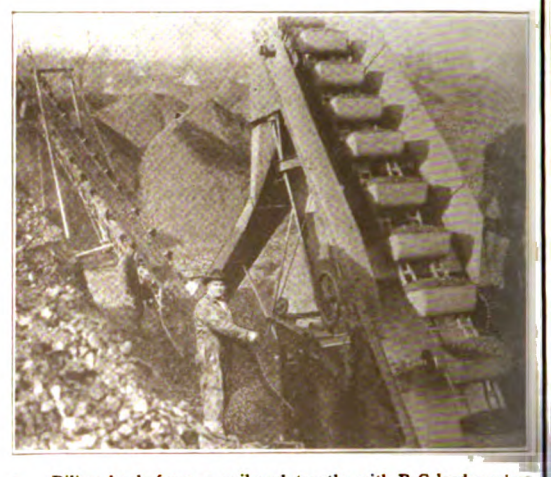
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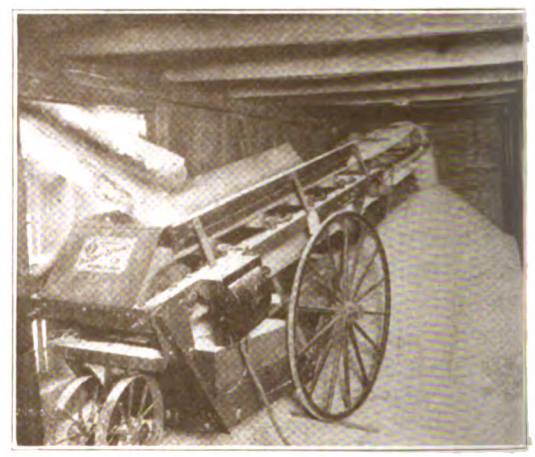
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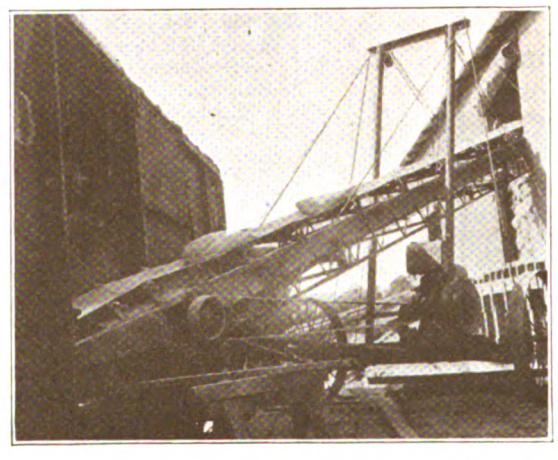
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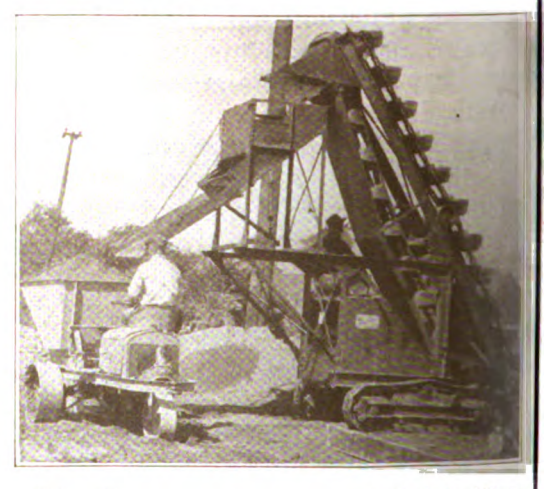
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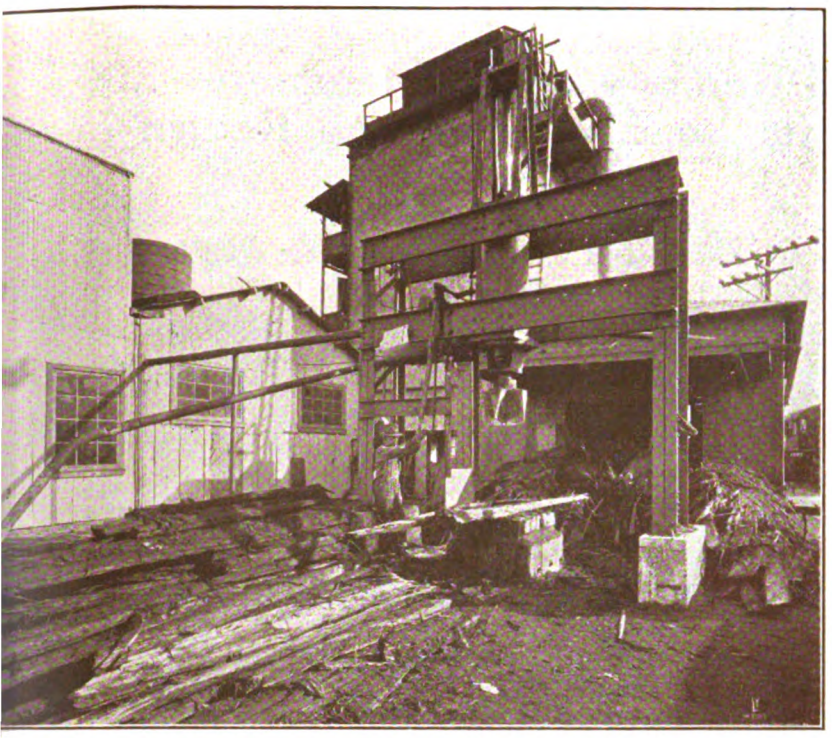
Barber-Greene Company

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pecially Designed Steam Operated Ax Cuts Up Red Wood Bark

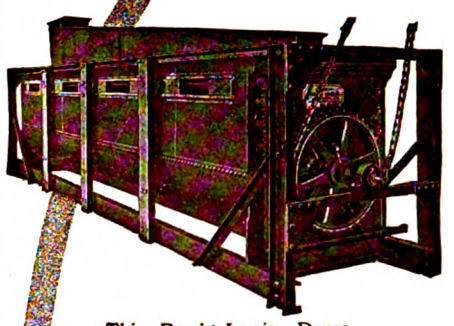


REDWOOD bark is so tough that it cannot be up by a saw and as a re- t the Paraffine Companies . of San Francisco have de- ned a special steam oper- d ax, which chops the bark so that it can be shreaded use in manufacturing pur- ses.

This steam operated ax has done away with a crew of men who formerly were employed in chopping the bark up by hand axes. It takes but a few blows of this power chopper to equal the work of a hand ax for an entire day, and the resulting product is in better shape for shredding.



Solving Your Drying Problem



This Brecht-Lewis Dryer turns out greater volume—faster, better and cheaper.

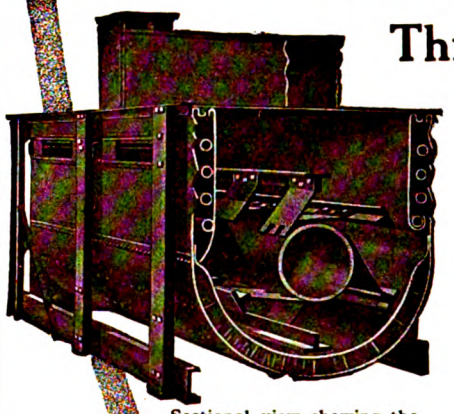
MANY drying problems vanish with the installation of a Brecht-Lewis Dryer. Greater volume, more perfectly dried product, and with lower steam consumption and H.P. used—that is the remarkable accomplishment of this new departure in dryers which can be operated either as a batch or continuous dryer at a saving over other systems.

BRECHT-LEWIS DRYER

(PATENTED)

The Brecht-Lewis Dryer opens a new era of economy in the drying of all materials of a loose, shredded or granular nature. Successfully handles:—

Apple Pomace
Alfalfa Meal
Beet Pulp
Bagasse
Bone
Carbonates of Lime, Potash or Soda
Cereal Products
Chalk
Charcoal
Clays
Coal
Coffee
Copra
Cork Chips
Cotton Seed Meal
Fish Scrap
Garbage
Grains
Graphite
Gravel
Gypsum
Kaolin
Leather Scrap
Lime
Marl
Metal Chips
Nitrate of Ammonia
Nitrate of Potash
Packing House Products
Peanut Hulls
Peat
Phosphate
Pumice Stone
Rice
Salt
Sand
Sawdust
Silica
Soapstone
Sugar Refuse
Talc Rock
Tobacco Stems
Whiting, and many other materials



Sectional view showing the improved method of heating and agitating—the secret of this dryer's efficiency.

Three Dryers In One!

This new design is really three Dryers in one; a combination of direct and indirect heat dryer allowing heat control from three sources—

1. From the steam drum,
2. From the jacketed bottom,
3. Hot air forced in from the side coils,

and is therefore adaptable to materials requiring either high or very low temperatures.

Hot air under pressure carries away the released moisture without recondensation.

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1219 Cass Ave. St. Louis, Mo.

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The Brecht Company,
1219 Cass Ave., St. Louis, Mo.

Please tell me, without obligation on my part, how the Brecht-Lewis Dryer is adapted to my business, and how it will effect economies for me.

Quantity of material to be dried daily .....

Percentage of moisture in mixture .....

Percentage of moisture to be removed .....

Firm Name ..... Address .....

Attention of ..... Title .....

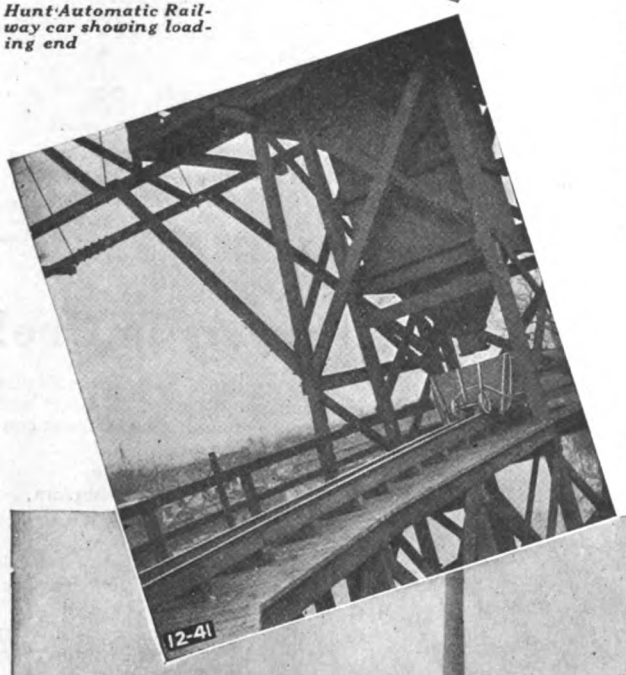
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Hunt Automatic Railway car dumping load in yard



Hunt Automatic car over storage bins



Hunt Automatic Railway car showing loading end

How's This for Speed?

This Car will Run — without attendant — 300 feet, Dump its Load of Coal and Return in 50 Seconds.

Quick work you must admit! But that isn't all—there's GENUINE ECONOMY wherever this system is used— and Safety too.

HUNT AUTOMATIC RAILWAY

Absolutely self-acting from time of starting with load, until it returns empty and ready for another load.

The cost of operating is confined to *one* man's wages. The workman at the loading end fills car and starts it down track,—but does not accompany it—it automatically dumps the load at any desired point and returns under action of gravity.

Coal can be accurately weighed without delay or extra expense, by placing platfom scales at loading end, (in the tracks). The loader weighs the car and while car is running down the tracks, enters the weight in the tally book.

Track and supports can be easily erected; the whole system is free from any confusion of switches, turnouts, ropes, etc. No loose pieces to get stolen or lost; nothing to take care of or put away. Cars left just as used and are ready for work at any time. Good for at least 10 years service without repairs—(We have records of 30 and 40 years).

Can also be used for transporting sand, phosphate rock, clay, ores, limestone, salt, cement and similar bulk materials from railroad cars and vessels to storage bins or pockets.

The Efficiency, Economy and Safety of the Hunt Automatic Railway is fully described in Booklet 20-3.

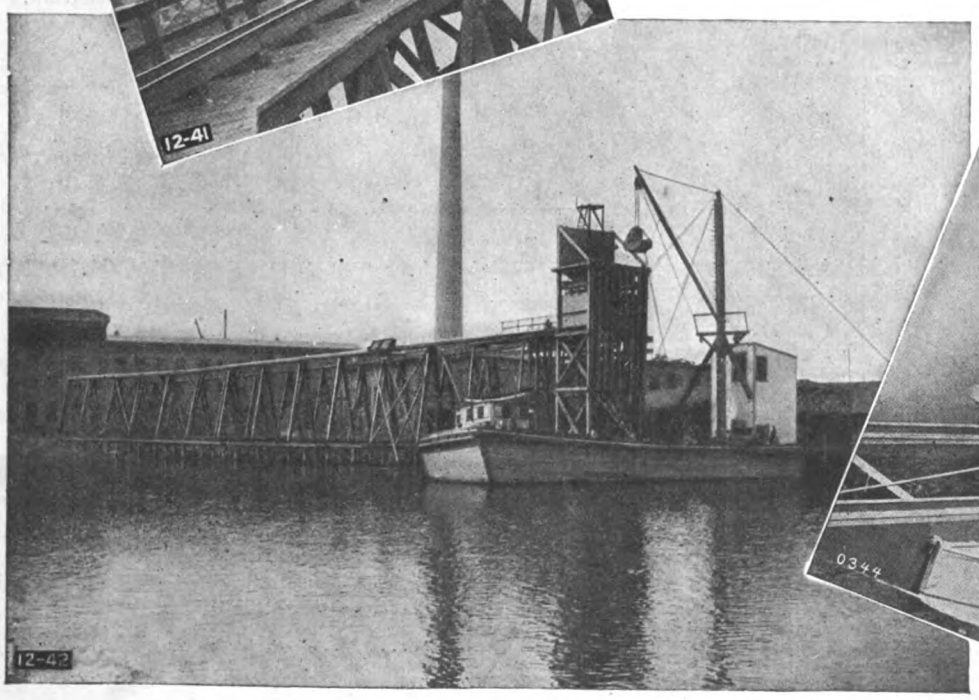
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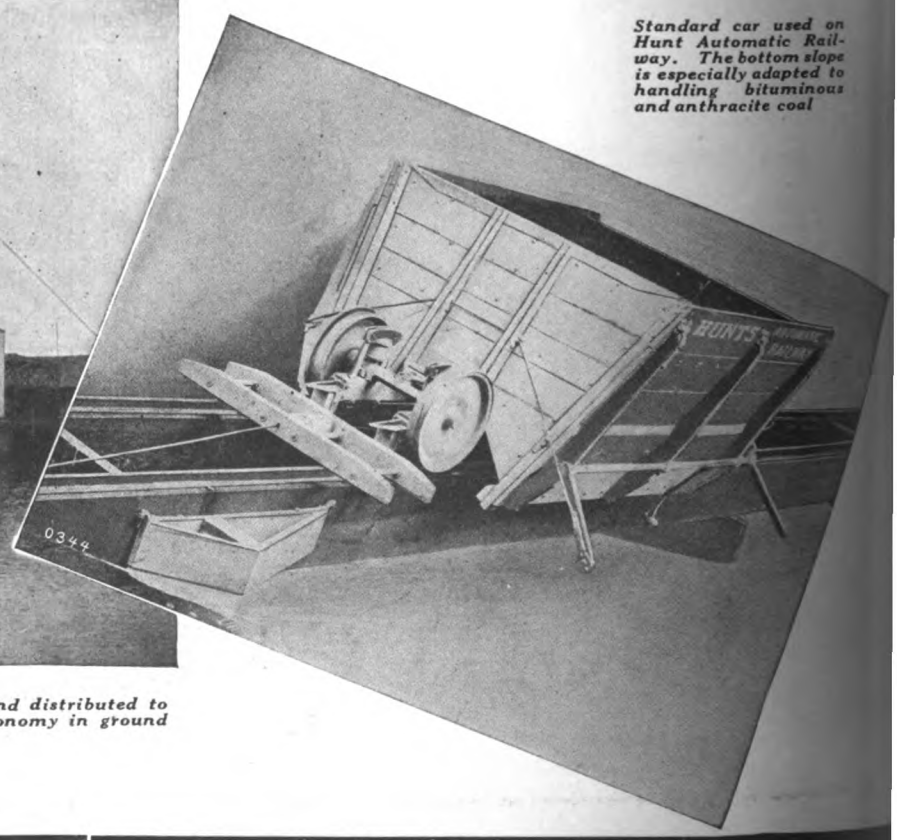
New York Office, 143 Liberty Street

Ernest F. Learned
141 Milk St., Boston 9, Mass.

Philips, Long & Co., Inc.
538 So. Dearborn St., Chicago, Ill



Coal received by water, is hoisted by a grab bucket on a Hunt mast and gaff and distributed to storage under the trestles of Two Hunt Automatic Railways. The utmost economy in ground space is thus secured



Standard car used on Hunt Automatic Railway. The bottom slope is especially adapted to handling bituminous and anthracite coal

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CTOBER 1922

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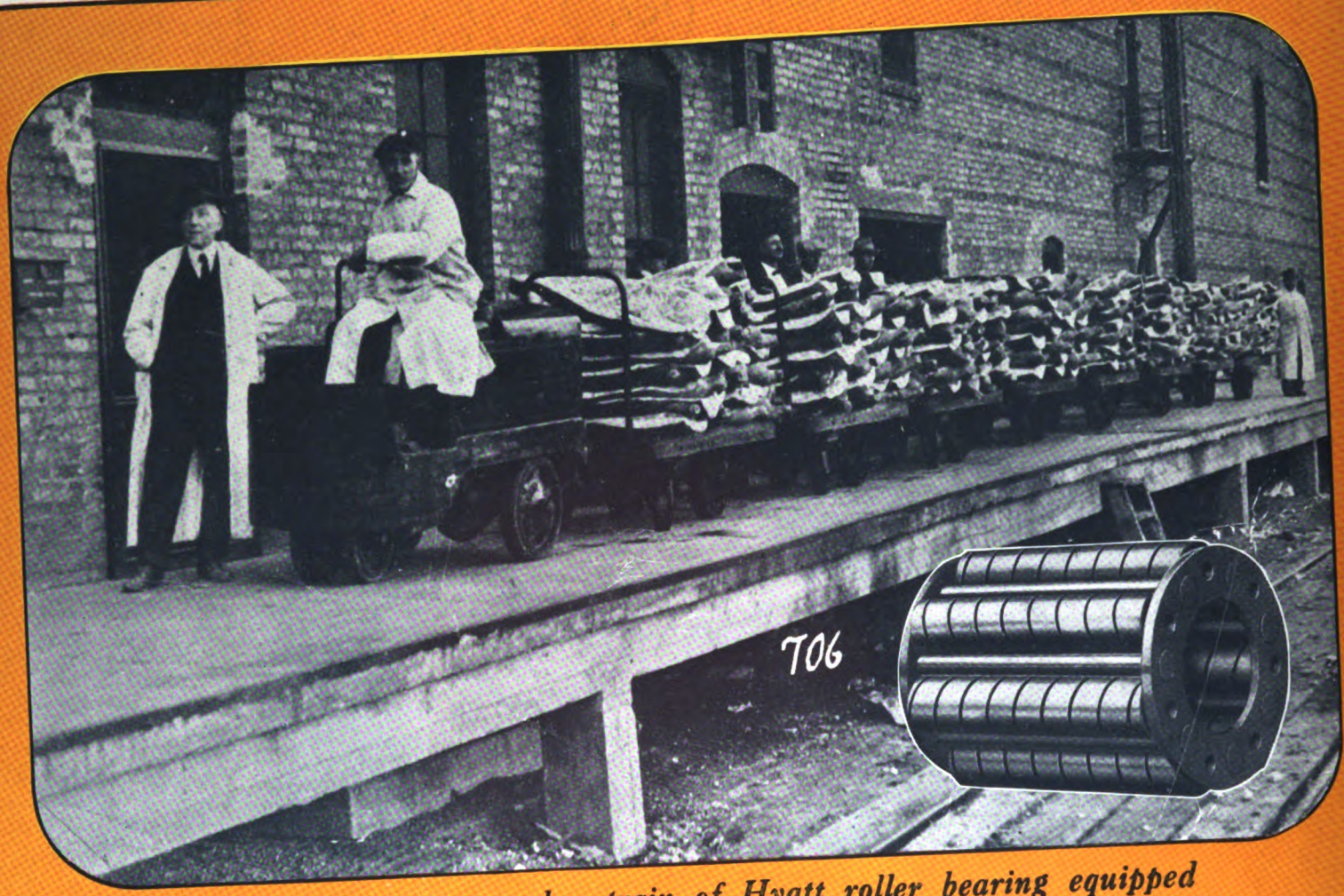
Industry Illustrated

1949

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Men, Methods and Machinery of Modern Management

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A Mercury tractor and a train of Hyatt roller bearing equipped Mercury trailers working in the plant of the Cudahy Packing Company, Cudahy, Wis., transferring pork sides.

Trailers That Successfully Resist Wear

The economies of maximum loads per trailer and maximum trailers per train can only properly be secured when sturdy, easy running trailers are used.

The uninterrupted carrying of heavy loads requires trailers that are well built of good materials. Hyatt bearings, with their sturdy steel rollers, are important parts of dependable trailers because they stand up under the heaviest loads throughout years of service.

A tractor can pull twice as many Hyatt equipped trailers as plain bearing trailers because Hyatt bearings provide a true rolling motion in place of the sticking, rubbing friction of plain bearings.

Specify that your new trailers be Hyatt equipped or apply Hyatt replacement wheels to your present trailers, and learn the economies of maximum loads per train.

Hyatt Roller Bearing Co.

Motor Bearings Division, Detroit
Tractor Bearings Division, Chicago

Industrial Bearings Division

USE HYATT BEARINGS ON YOUR LINE SHAFTS TOO
BULLETIN 127

New York, N. Y.

Pacific Coast Division
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INDUSTRY ILLUSTRATED

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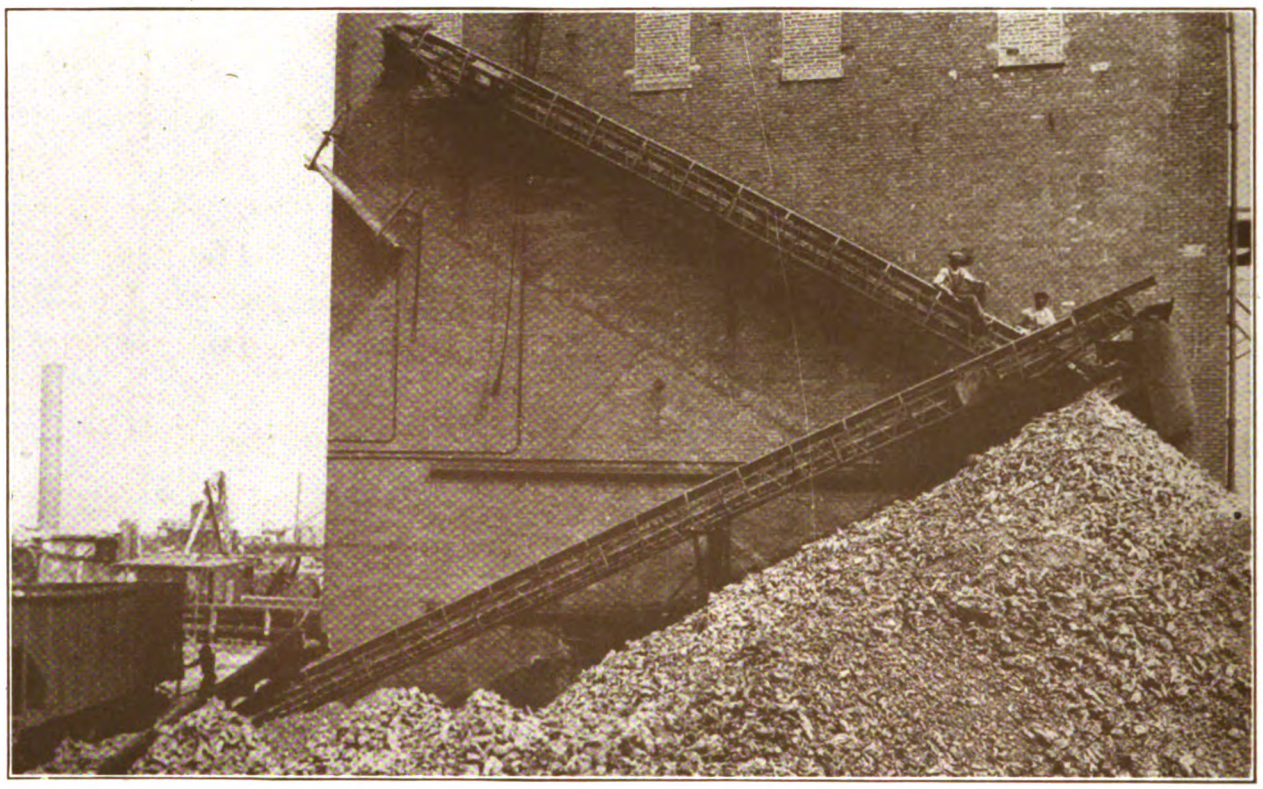
COST REPORT SERIES 4

Presenting certified figures on the operating costs of B-G. Machines.

No part of this report written, altered or even seen by Barber-Greene.

Finished report as quoted here is only report which was delivered to us.

Conveyors Save $1672% Yearly



AT the plant of the General Carbonic Company, Long Island City, New York, 2 men and the Barber-Greene conveyors shown do work in 21-3 hours which formerly took 5 men 1 1-2 days.

The savings in handling costs amounts to $1672.00 a year and at the same time the "floating gang" has been eliminated.

Mr. F. W. Harper, superintendent, reports as follows:

"Our series of 3 B-G conveyors handle coke at a cost of $5.68 a day. This represents a saving of $1672.00 a year over the cost of handling and storing the material in our yard by hand.

"We have a 1200 ton storage bin which it would be impossible to use without some kind of conveyors for loading it and the small tonnage handled would make pivoted-bucket carriers too expensive. The alternate method would be to store our coke in the yard. This is what we used to do, and originally handled all the material by hand."

Exact cost figures on this job are given in a report prepared for us by the H. P. Gould Company, industrial auditors. Mr. Harper has certified these figures. It is easy to send the coupon. Tear it out and send it today.

B STANDARDIZED MATERIAL-HANDLING MACHINES G

BARBER-GREENE COMPANY
470 W. Park Avenue, Aurora, Illinois

Please send Cost Report No. . I am interested in handling

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Company
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City
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A Message to Executives

HOW much would you be willing to pay for an organization of men who have been specially trained for production work?

YOU have the men—We have the method—and it does not involve a single dollar of expense on your part.

Your problem is to get volume of production at low cost. To get volume you must get standard quality, and uniform operation. For certainly every sale starts in the plant. If your methods of purchasing, handling materials, planning and scheduling production, laying out equipment, generating and distributing power, controlling labor, and establishing costs are not sound, then your sales department cannot function successfully in the face of intelligent competition.

Economical production is possible only if the key men and department heads in your organization are equipped to get close to 100% effectiveness out of your material equipment, and out of the men they supervise. But the key men usually know only those things about production work which they have learned by personal experience in one or possibly two departments, and in just one branch of manufacturing.

Give to them a comprehensive knowledge of methods and principles which have been successfully established in many other plants, and in other branches of manufacturing, plus a perspective of the activities of all departments in a modern industrial organization and they will constitute a more dependable, a more intelligently working organization. They will direct the men under them more effectively and they will help you directly to solve those problems which are arising every day in your plant.

The Industrial Extension Institute has been co-operating with many industrial organizations by training their men through the Factory Management Course and Service.

This is a thoroly practical course in industrial engineering and management, prepared by more than 100 industrial specialists of national reputation. Each one of these men has put into the Factory Management Course and Service those essential things in the way of method and principle which he has demonstrated as successful and practicable during his many years of practice in the industrial field.

The successful experience of other large industrial organizations in having the training brought to their men should indicate the opportunity of strengthening your own organization.

If you will telephone or write to the Institute one of our directors will be glad to arrange an interview for further details of our plan, which means no expense to you.

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The Only Complete Course in Industrial Management

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THE MOST ECONOMICAL AIR COMPRESSOR AND VACUUM PUMP

NASH HYTOR

THE HYTOR COMPRESSOR is valveless, has no gears, loose moving or reciprocating parts, no piston packing to renew, no cylinders to lubricate and no bearing adjustments to make.

The rotor, the only moving part, is cast in one piece, the blades being rigidly reinforced by shrouds. The rotor is mounted on a short, stiff shaft supported at each end by the highest grade annular ball bearings mounted outside of the casing.

As the peripheral clearance is large, there is no possibility of the ends of the rotor blades coming in contact with the casing.

The original high efficiency is maintained indefinitely in continuous service.

The air is thoroughly washed during compression and contains no oil.

Hytor compressors occupy very much less floor space and are much lighter in weight than reciprocating compressors. They run without vibration.

The cost of installation is greatly reduced as no expensive foundations are necessary.

No expert attendance is required as there are no adjustments to make. The cost of upkeep is negligible.

Hytor compressors are quiet in operation.

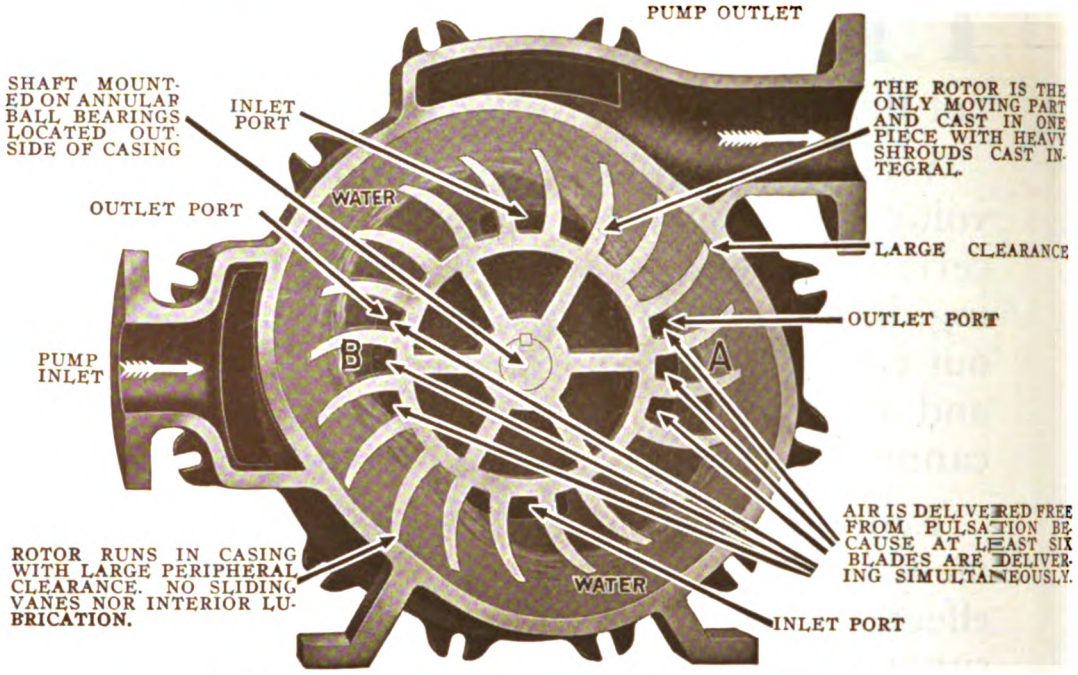
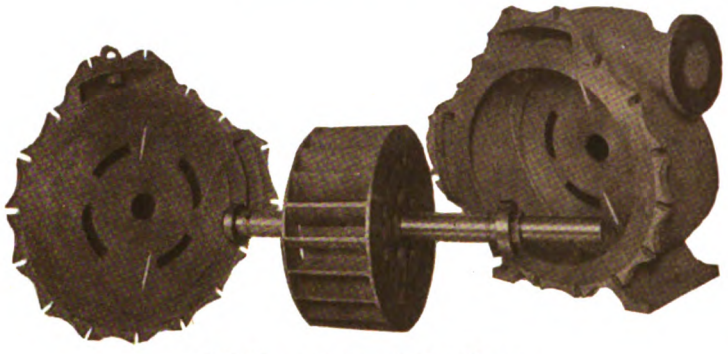


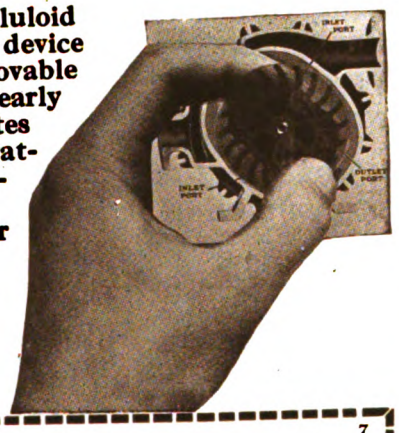
Diagram illustrating unique principle of operation



A ROTOR in hydraulic balance revolves freely in an elliptical casing filled with water. The water, turning, with the rotor, and constrained to follow the casing by centrifugal force, alternately recedes from and is forced back into the rotor, twice in a revolution. As the water recedes from the rotor it draws in air through the inlet ports. When the water is forced back into the rotor by the converging casing, the air is first compressed and then discharged through the outlet ports.

All the parts of the Hytor

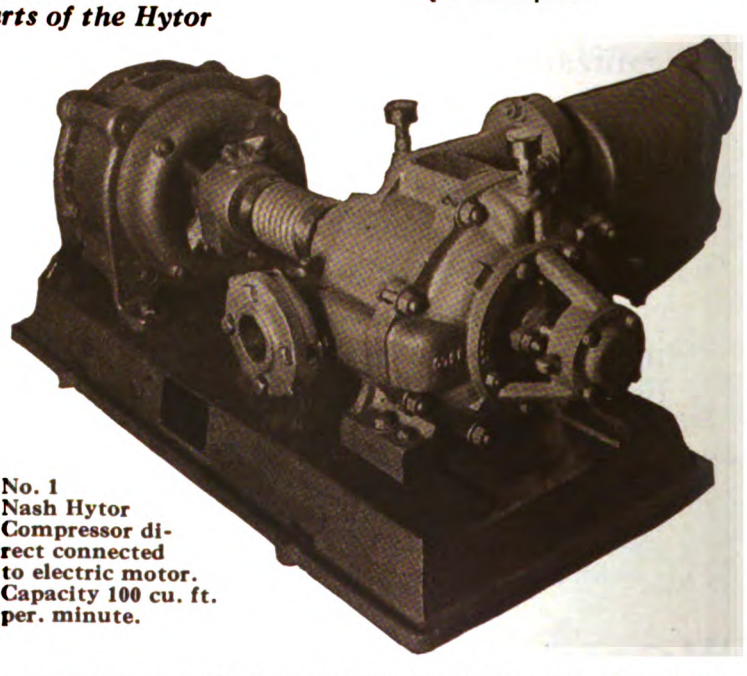
This celluloid graphic device with movable rotor clearly illustrates the operating principle. Send for your copy.



At pressures up to and including 15 lbs. per square inch, and vacuums up to 20 inches of mercury, the Nash Hytor affords the simplest and most economical means for handling air or gas, for all of the usual purposes where air under pressure is required, and they can be used on many special services for which the ordinary compressor is not adopted.

It is common practice in handling mildly acid vapors to re-circulate thru the pump an alkaline solution for the protection of the cast iron structure of the pump. In handling chlorine gas, concentrated sulphuric acid is re-circulated.

Air handled by the Hytor is delivered absolutely clean and free from dust or oil; a great advantage in the agitation of good products or in absorption processes where diffusion of air is accomplished by blowing thru filters, porous blankets or small orifices.



No. 1 Nash Hytor Compressor direct connected to electric motor. Capacity 100 cu. ft. per. minute.

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Industry Illustrated

John H. Van Deventer, Editor

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EDITORIAL

Today's Cost Cutting Tools

TIMES change and men and methods change with them.

Today the center of interest in cost reduction is the process as a whole. Ten years ago it was the individual machine.

For example:

Just about ten years ago, before there was such a thing as war-production or "cost-plus," the General Manager of a large manufacturing plant was told by his president that somewhere, somehow, production costs *must* be reduced—the where and the how, being for the G. M. to discover. The experience was not unique. It was, in fact, typical of the experience of hundreds of General Managers and Plant Superintendents; and his reaction to it, too, was typical.

This typical General Manager of ten years ago scoured the machinery market for machines that would better the performance of those in his plant. He speeded up, wherever possible, the individual machines; studied the individual operations with a view to saving time or labor on any or all of the operations performed; studied the layout of his machines, to secure better grouping and in some cases to put several machines under control of one man instead of two or three. By dint of any or all of these things—dispensing with an operative, cutting a few seconds off an operation, increasing the production of some of his machines—the General Manager of a decade ago brought his production costs down another notch.

But this was ten years ago—and a vast amount of industrial progress has been written into these ten years.

The problem today is not the same as it was ten years ago. The past decade has seen a perfection of machine design undreamed of before. The modern plant already has installed the best machines available for each of its operations. Moreover, these machines are capable of producing, in most cases, in excess of the plant's ability to use their output. There is scant hope of cost-cutting through better machines. Again, the modern plant has taken care of layout and grouping of operations; has already trimmed the seconds from its time per operation; has in most cases dispensed with every non-essential operative.

The General Manager of ten years ago was like the man who couldn't see the forest, because of the trees; his problem was one of perfecting the individual operations. Today, his problem is the process as a whole: with the individual steps perfected, *it is the gaps between these steps, that must be attacked.*

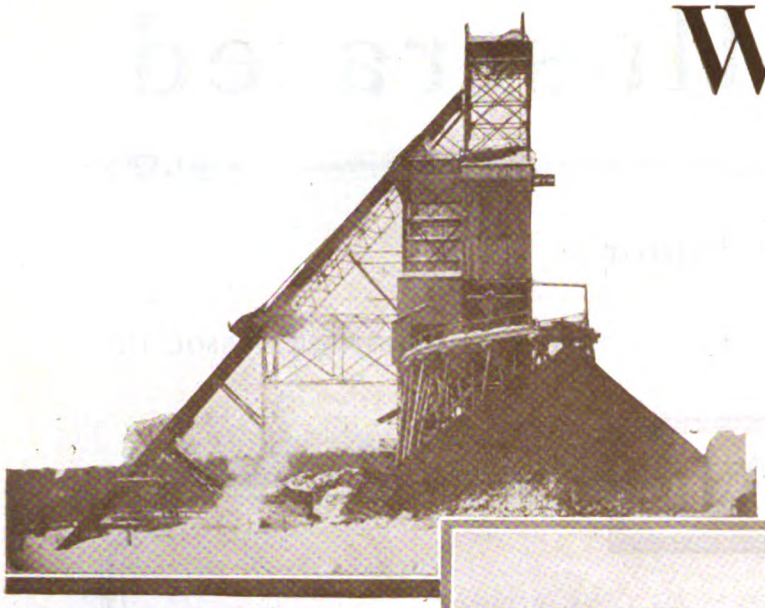
Every place in the plant where a man lifts or carries a part in process, there is waste. Every time a man picks up a part and puts it down, there is waste. Every place where partly finished stock accumulates, there is waste. And every time a machine is held up while work is being brought to it, there is waste. Waste of labor, which cannot compete with machinery in lifting or transporting; waste of time, through lack of co-ordination of all elements in the entire process; waste of money, through the staggering sums tied up in partly finished materials—money which must bear interest charges for every day these materials take to become salable products.

Shop trucks, lift trucks, cranes, hoists, conveyors—these are the *transportation* tools of cost-reduction today. Not merely in the speeding of individual operations, but in the speeding and co-ordinating and synchronizing of the whole process, lies today's broad path to lower costs of production.

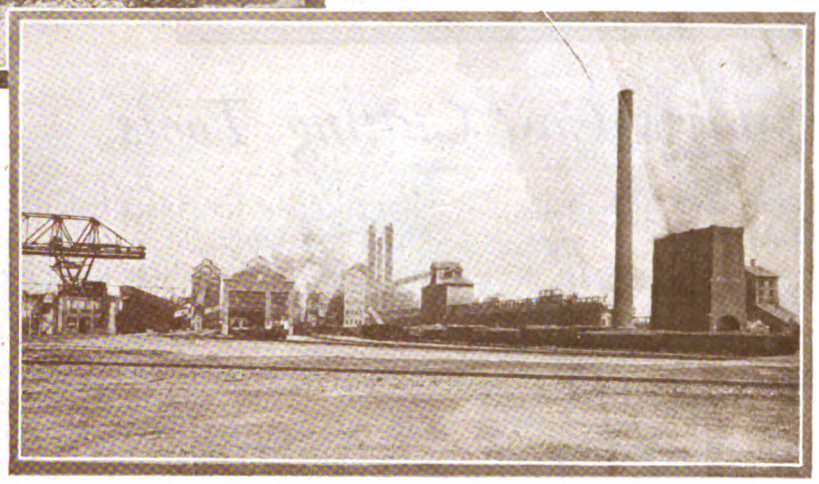
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What Ford Is Doing

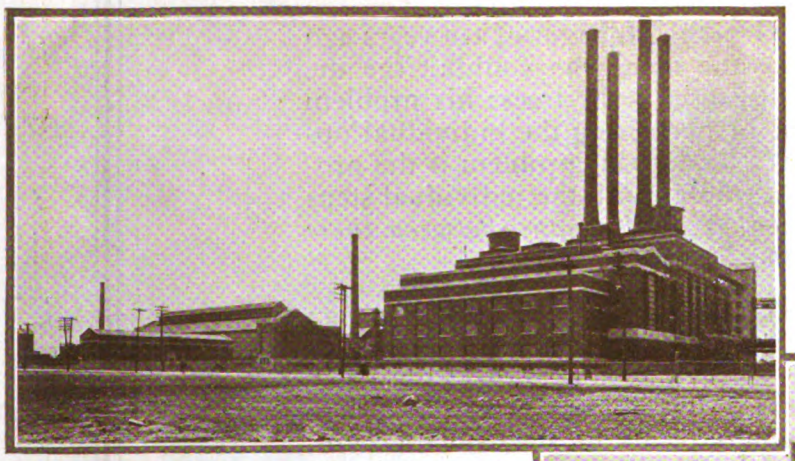
By John H.



(1) The Ford industrial chain starts with the basic raw materials, iron and coal. This view shows a pile of ore at one of the Ford mines.

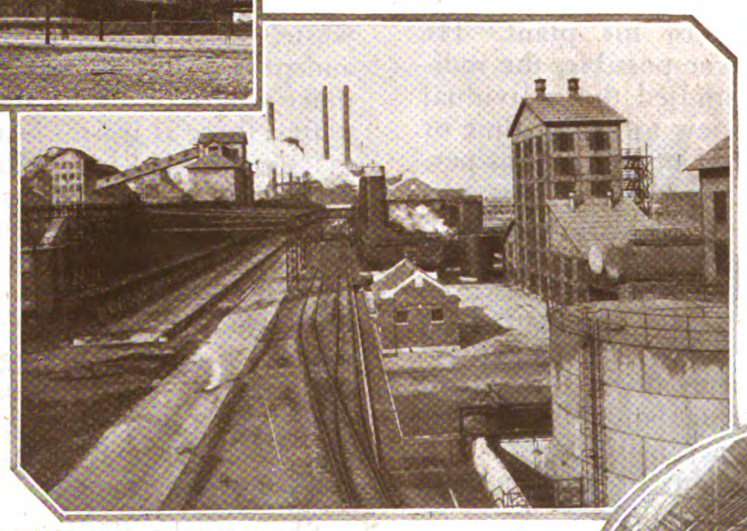


(2) Above—The southwest end of the River Rouge Ford plant, showing (at the extreme left) the "High Line," and in order from left to right: the Coke Screening Building, the D. T. & I. Railway Shops, Coal Breaker with Conveyor to Coke Oven Coal Pocket, Coke Ovens, Coke Oven Stack, and Coke Quenching Tower.



(3) Central Power Building at River Rouge. Its four 330 ft. stacks are to be supplemented by four more, giving the plant over one hundred thousand kilowatts power production.

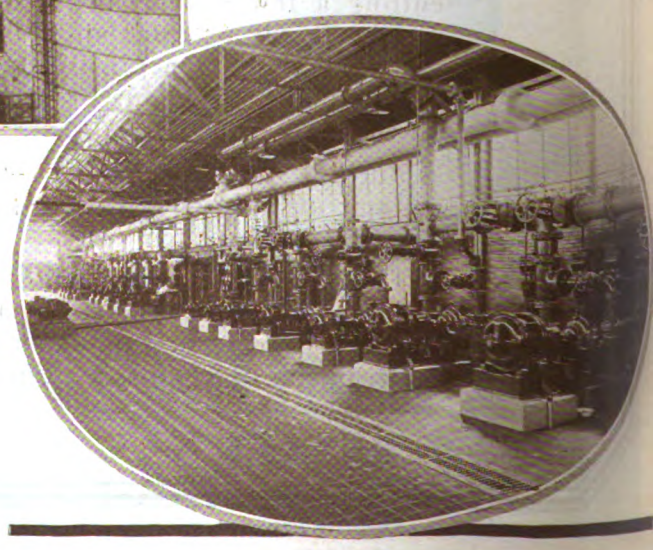
(4) At the right—A block of Coke Ovens are shown at the left of this view, with mains which convey the gases to the by-product plant. Producing a daily average of fifteen hundred tons of coke, the plant recovers some 22,000,000 cubic feet of illuminating gas, 10,000 gallons of motor benzol and many tons of tar and fertilizer.



(5) Below—The foundry at River Rouge—largest in the world—where, by means of moving platforms and conveyors, some 1,500 tons of iron are melted daily.



(6) Below—A section of the By-Product-Plant Pump-House, giving an idea of the scale of operations. These pumps are used only for circulating ammonia liquor for by-product extraction.



IT has been well said that a visit to the great River Rouge plant of the Ford Motor Company is necessary to provide the completion of a well rounded industrial education, because one can think of almost any problem in the effective utilization of modern machinery in making an engineering product, and forthwith find the answer to that problem in one or more of the forty-three buildings and departments of this plant. Unlike other machinery or motor car building establishments, Ford at River Rouge, carries his manufacturing process all the way back to the basic raw materials—iron, coal and limestone.

Thus, the River Rouge plant of the Ford Motor Company is virtually one huge machine (taken in connection with Highland Park and the many widely distributed assembling plants) for converting ore coal and limestone into tractors, trucks and motor cars. Such an exceptional plant naturally presents features of interest above and beyond those found in more conventional engineering works, to say nothing of the interest which always attaches to a Ford undertaking.

Henry Ford as demonstrated by his works, is undoubtedly an outstanding industrial genius. Steady growth of his company from a small beginning nineteen years ago to its present almost inconceivable proportions (in Detroit alone the Ford Company employs over 80,000 men or close to one quarter of the entire working population) demonstrates this fact conclusively. During this

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and How He Does It

VAN DEVENTER

period of nearly twenty years his company has never experienced a strike.

River Rouge is the latest of he big Ford developments. Located on the river which bears that name the plant extends for a mile and a half in length and three-quarters of a mile in width. It is a busy area crammed full of the most up-to-date and ingenius machinery that money can buy nd brains develop. But contrary to the general conception f those not acquainted with his plant scarcely ten percent. f this machinery can be designated as "special."

From the huge coal and ore nloaders on through the coke vens, blast furnaces, power ouses, foundry and machine hops, all of this machinery is o-ordinated into one big maine by a remarkable system f mechanical transportation. Raw materials, castings, coal nd coke, machined parts and onstantly growing assemblies ow through this plant in mehanical streams. Transporation sets the pace for production and no one can well or ong outwit a mechanical pace naker. Defective machines nd delinquent men are quickly and automatically revealed y this sytem and production ecomes a formula in which lineal feet of transportation er minute is the principal factor."

* * *

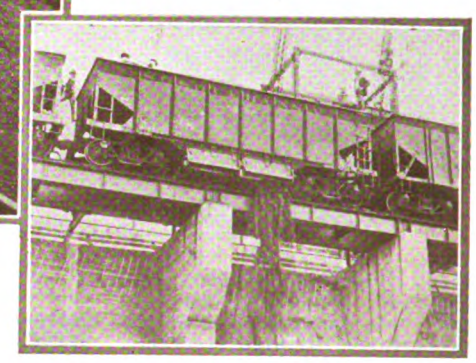
The Engineering Magazine Company, publisher of *Industrial Management* and *Industry Illustrated*, has been afforded the exceptional privilege of studying and describing this latest and most significant plant of the Ford Motor Company, just as it was privileged eight years ago to study and describe the great Highland Park plant of this same company. The presentation in this issue of Industry Illustrated and in other issues to come will be supplementary to the



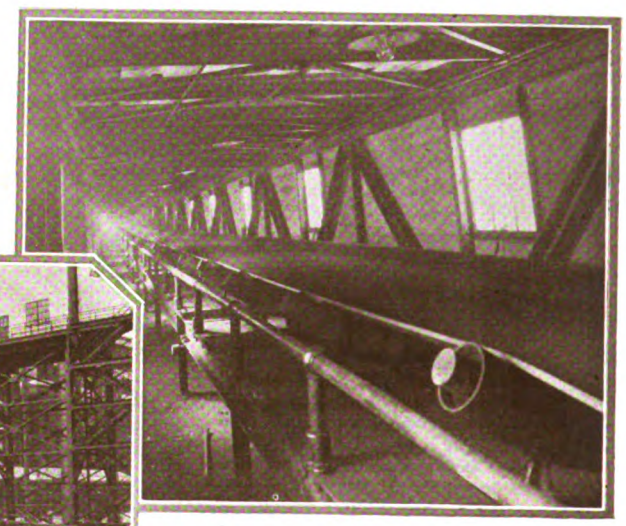
(7) A huge Mead-Morrison unloader of 625 tons-per-hour capacity, of which two are used in handling coal coming to the plant.



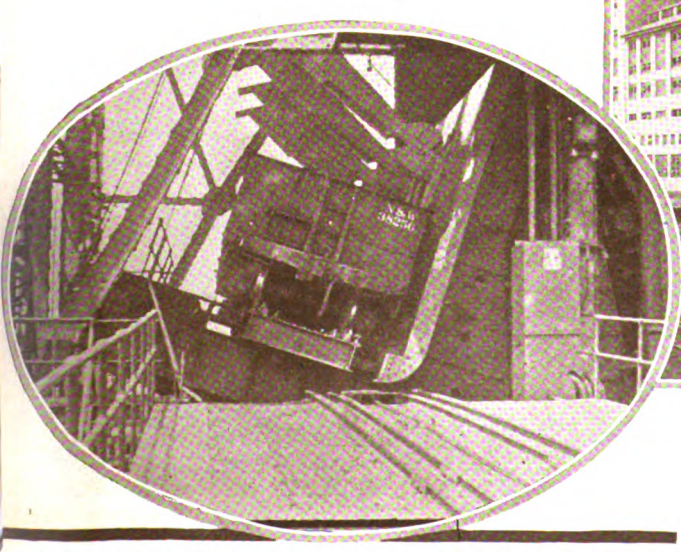
(8) The concrete primary storage bins, for coal, iron and limestone on arrival at the plant. The two ore bridges transfer these raw materials to transfer cars on the high line. Coal arriving by rail is dropped through the open girder trestle directly into the bins.

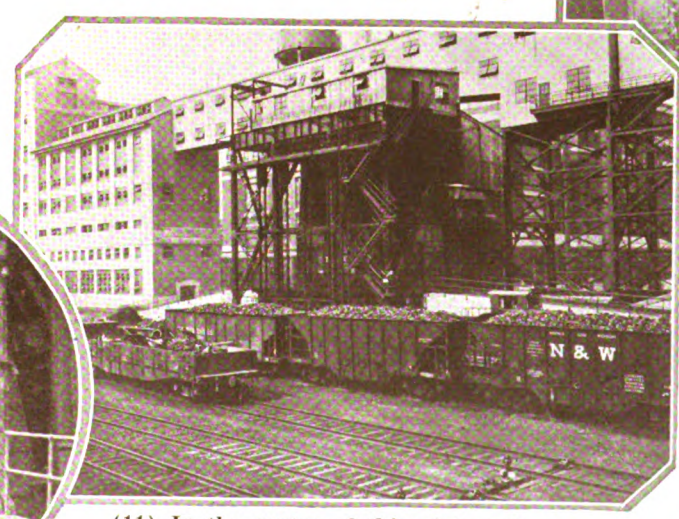


(9) Drop bottom cars may be dumped directly into the huge concrete storage bins at River Rouge. As shown in this picture and the preceding one, the "elevated railroad" overhanging the "High Line" makes this easy.



(10) One of the belt conveyors used on long distance coal and coke transporting. With a capacity of 640 tons per hour, this conveyor is typical of several used in this huge plant.



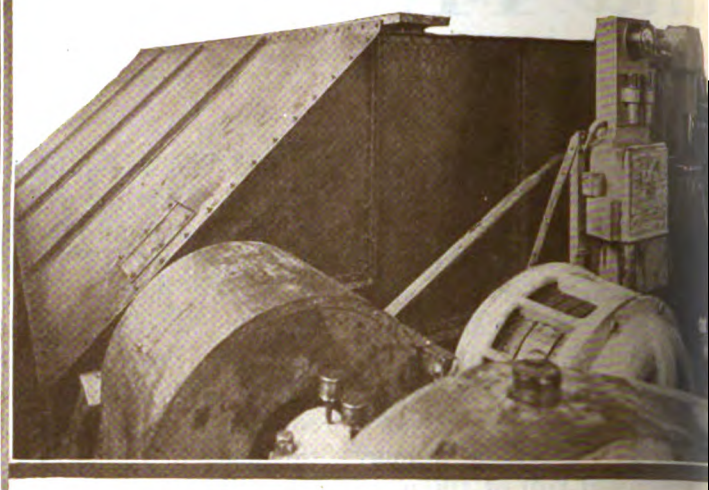


(11) In the center of this picture is the "car dumper" which, as shown in the adjoining illustration, picks up a loaded coal car and dumps its contents into hoppers. From here the coal goes via conveyor to the breaker building.

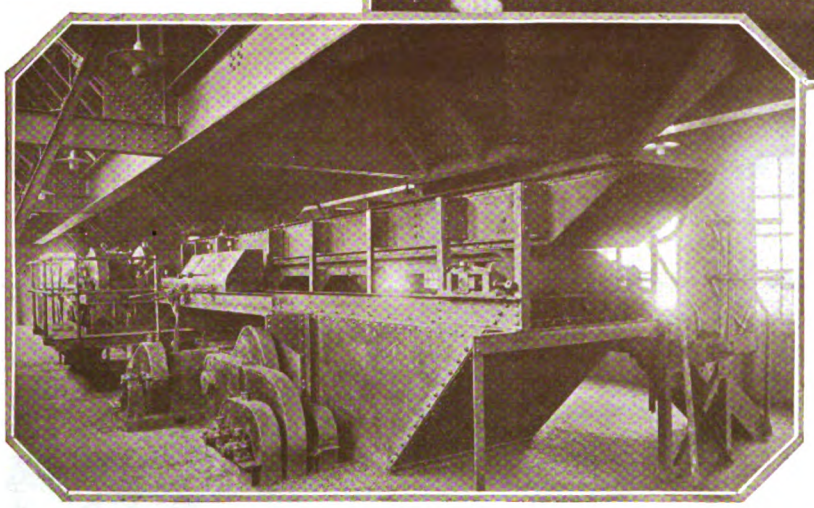
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(13) The crusher which reduces the large coal for coking, delivering it to conveyor for carrying to the mixer room.



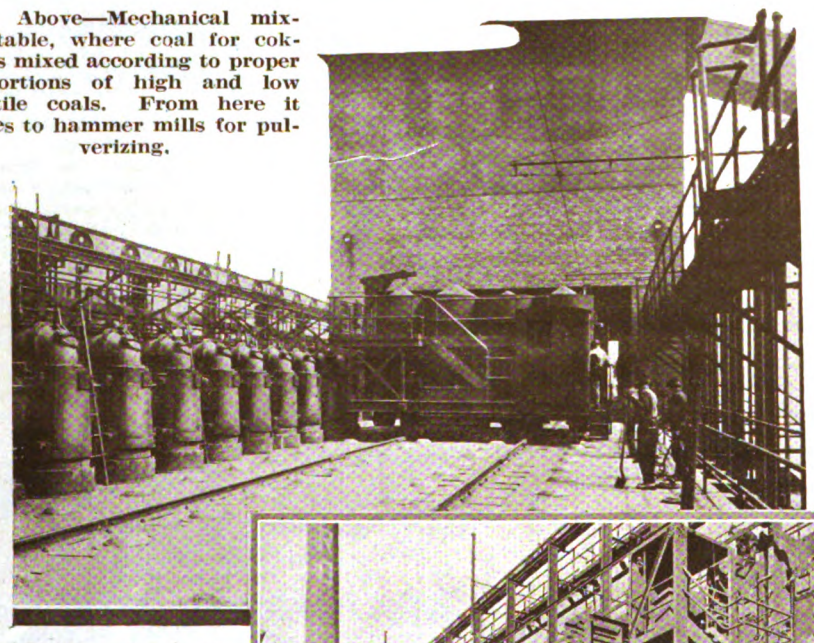
(12) Giving the coal its initial preparation for coking in the Breaker Building. Broken coal passes through the inch-and-a-half mesh screens, while the larger pieces pass on to the crusher.



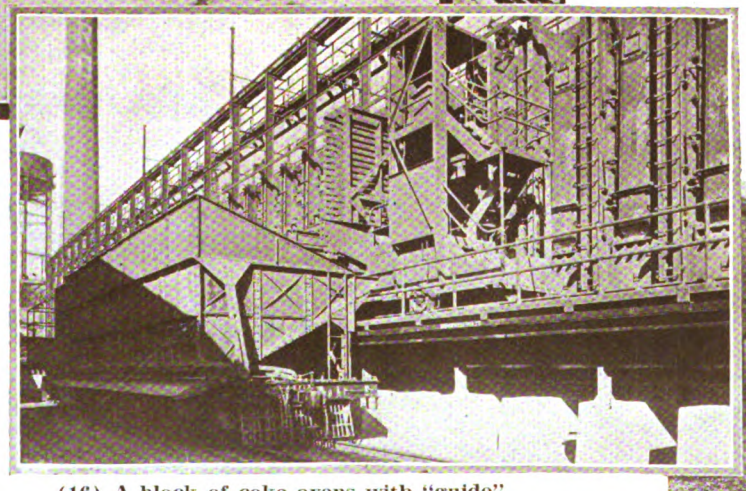
(14) Above—Mechanical mixing table, where coal for coking is mixed according to proper proportions of high and low volatile coals. From here it passes to hammer mills for pulverizing.



(18) The cast-iron-plate floor of the coke wharf is so inclined that the coke dumped on it slides down to the distributing gates. Here the conveyor-transportation of the coke begins.

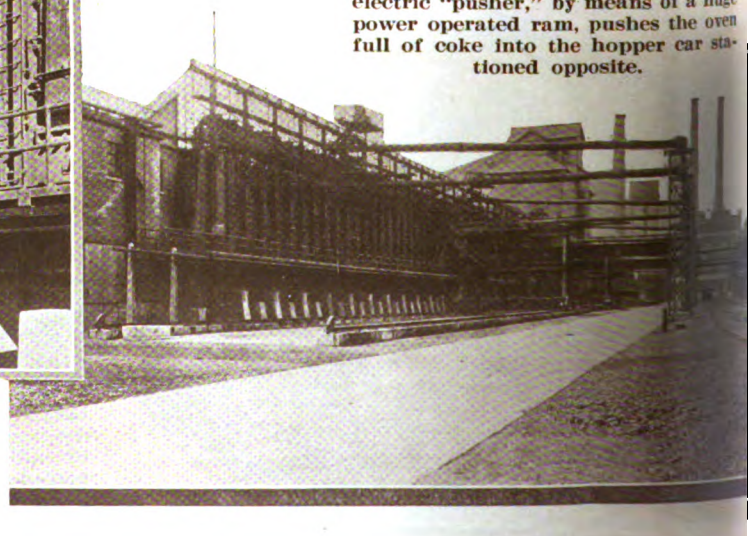


(15) Above—After pulverizing, the coal goes by conveyor to the charging bins; whence it is delivered to the coke ovens by electrically driven charging cars as shown here.

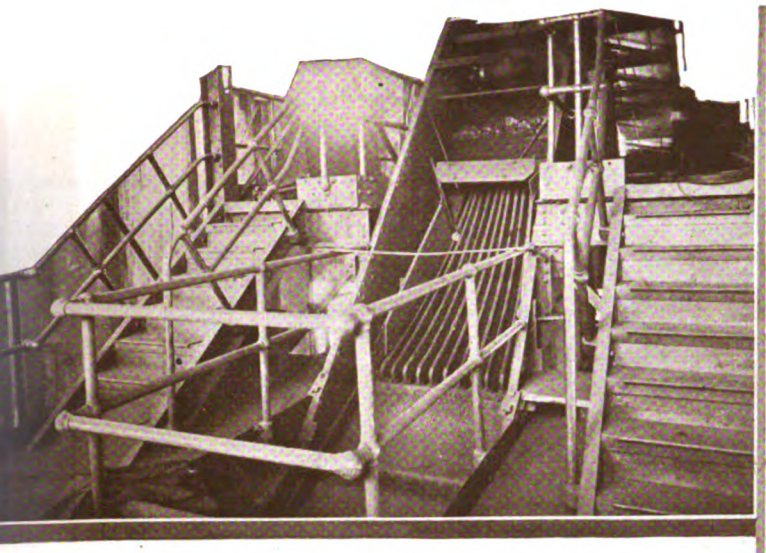


(16) A block of coke ovens with "guide" and hopper car in place to receive a finished oven-full of coke. Receiving its charge, the electric hopper car runs to the quenching station, where the coke is quenched, and then back to the coke wharf where its fifteen to sixteen tons of coke are discharged by gravity.

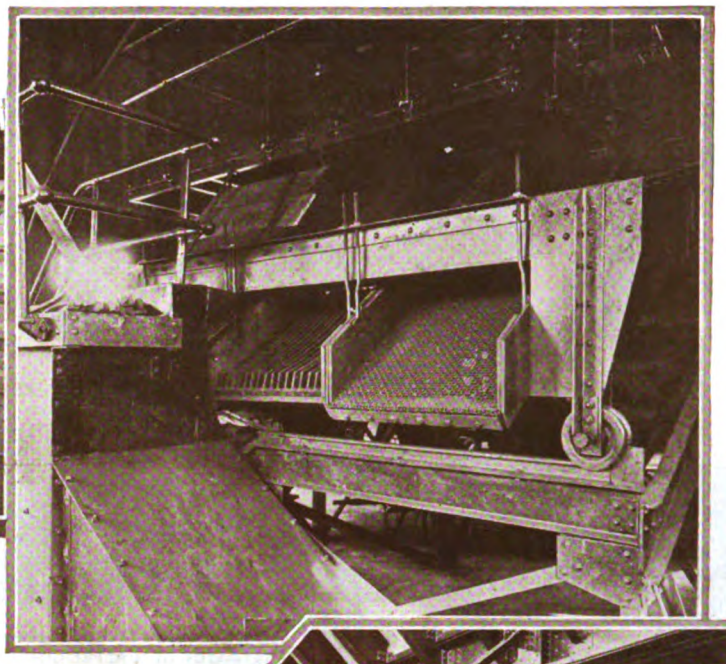
(17) Below—A view of the coke ovens from the side opposite to that which the coke hopper car traverses. The electric "pusher," by means of a huge power operated ram, pushes the oven full of coke into the hopper car stationed opposite.



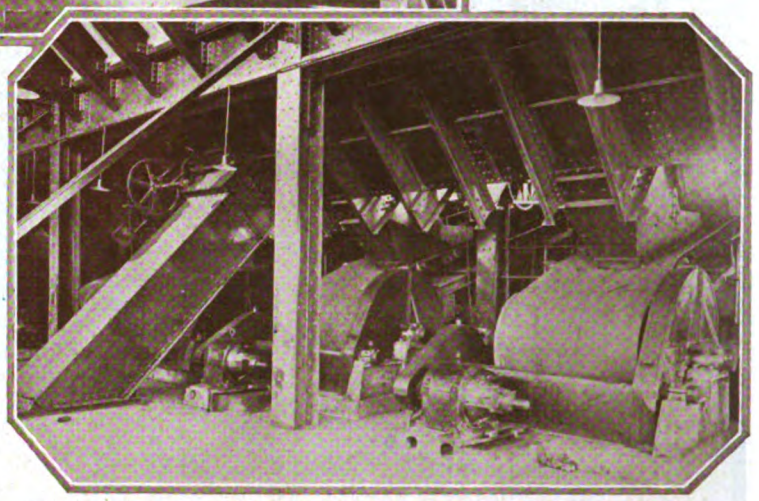
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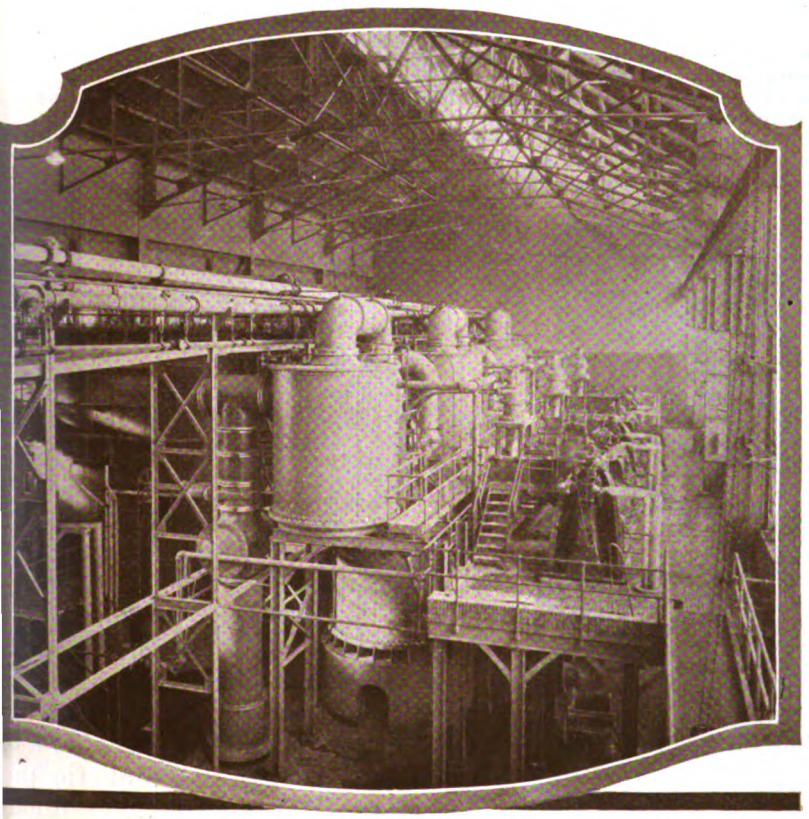
(19) One of the foundry screens, where the coke is separated according to size and delivered to the proper conveyors.



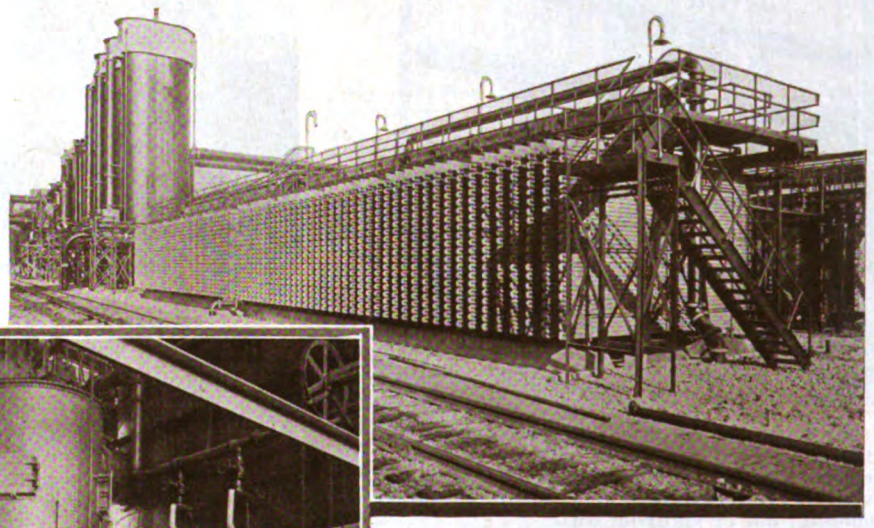
(20) Various sizes of screens and bars are used to grade coke that has passed the foundry screens into domestic, nut, pea, etc.



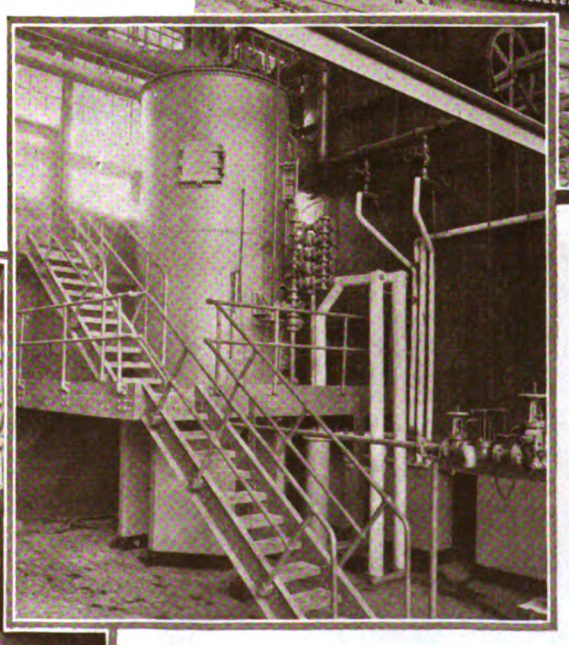
(21) Not far from where coal started on its travels, the coke finishes its journey. Here are the hoppers and belt conveyors under the "High Line," from which all coke (except foundry coke) is delivered to the High Line.



(24) A general view of the "Sulphate Plant," where the ammonium sulphate, second by-product of the coking process, is recovered.



(22) There are more than ten miles of pipe in these coils, which are used in cooling the ammonia liquor after it has sprayed the hot gases from the coke ovens to extract tar.

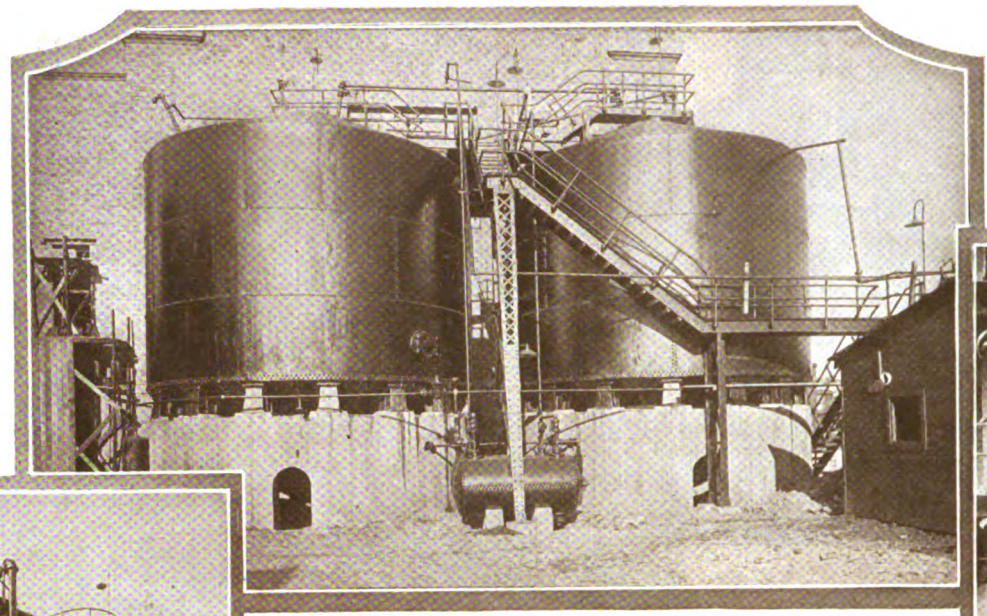


(23) At the left—The tar extractor, where the gases pass through small orifices and by natural expansion give up their tar in small globules upon striking the smooth surfaces beyond the perforations.

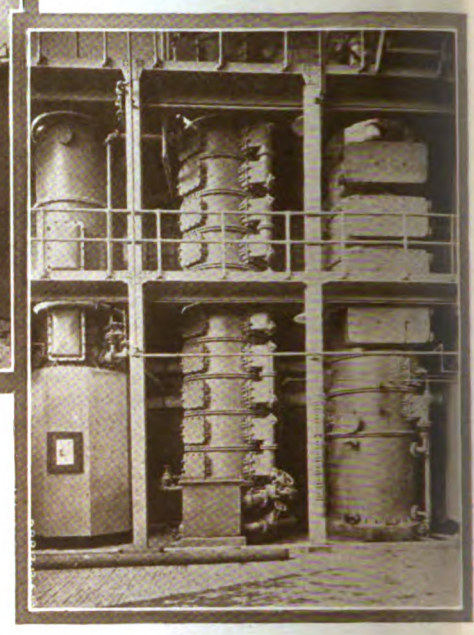


(25) At the left—An overhead travelling crane operating on the tracks seen at the top of this sulphate storage room, handles the finished fertilizer by means of a grab bucket.

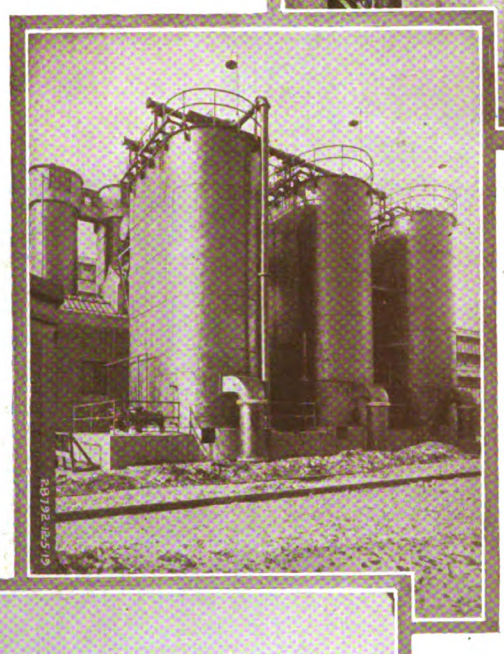
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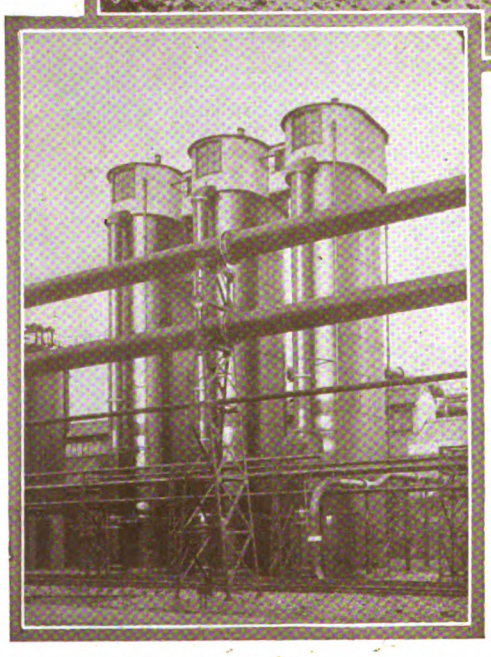
(27) Another view which gives an idea of the tremendous scale of operations at River Rouge;—the two huge sulphuric acid tanks, of 150,000 gallons capacity, which contain the acid used in the saturators for the extraction of ammonium sulphate.



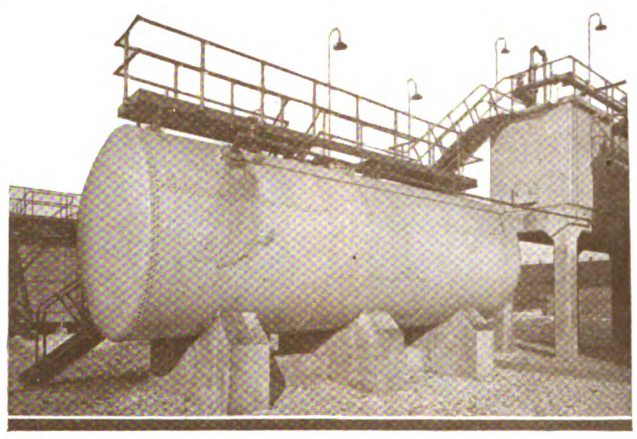
(26) At the right—The ammonia made in the "cooling and scrubbing" process (latter stage of tar extraction) is vaporized in the ammonia concentration stills shown here; adding this ammonia vapor to the gases entering the saturators, increases the yield of fertilizer.



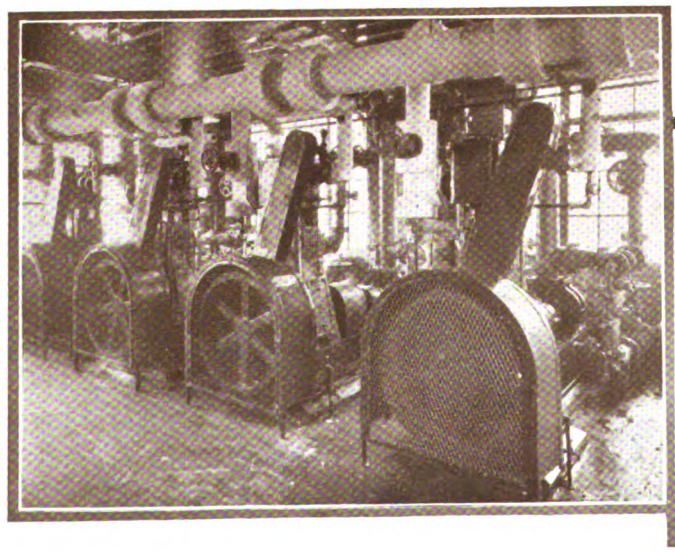
(28) At the left—After leaving the saturators, the gases (already freed from tar and ammonia) must be cooled—by spraying with water—to precipitate the napthalene.



(29) The light oil, remaining in the by-product gases after removing naphthalene, cannot be removed by direct cooling; but by spraying with "straw oil," this light oil is removed—somewhat as mercury assists in recovering gold or silver.

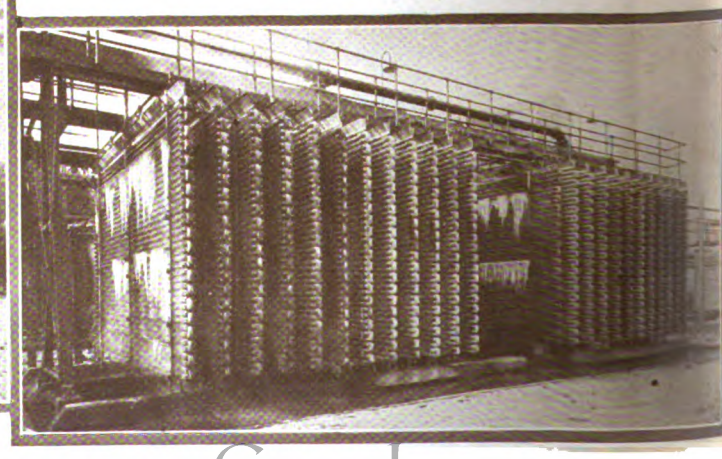


(30) This is the circulation tank, adjacent to the decanter, shown at the right, where the "straw oil" is stored for recirculation.



(31) The engine driven rotary pumps at the right, furnish the motive power for circulation of the "straw oil."

(32) After distilling the combination of "straw oil" and light oil to release the latter, the straw oil is then cooled in coils, as shown here, to be recirculated.

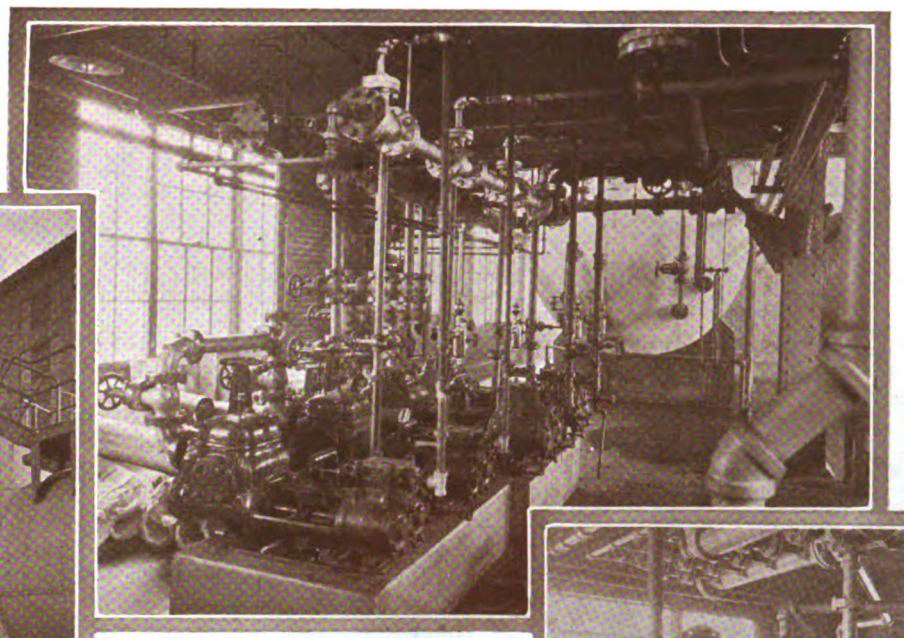


presentation of the Ford principles and practice now appearing serially in *Industrial Management*. The adequate description in any form of such a vast and variegated undertaking is difficult.

The conception of scope of the enterprise and its extent can best be conveyed pictorially. The principles underlying the operation of the various departments and the methods employed in them to produce a high quality product at an exceptionally low cost must be conveyed largely through text. Upon the pictorial background of *Industry Illustrated* we hope to paint a realistic picture of the great River Rouge plant—a picture that will be the next best thing to a personal visit, while in *Industrial Management* we are undertaking simultaneously a careful, detailed and thorough study of

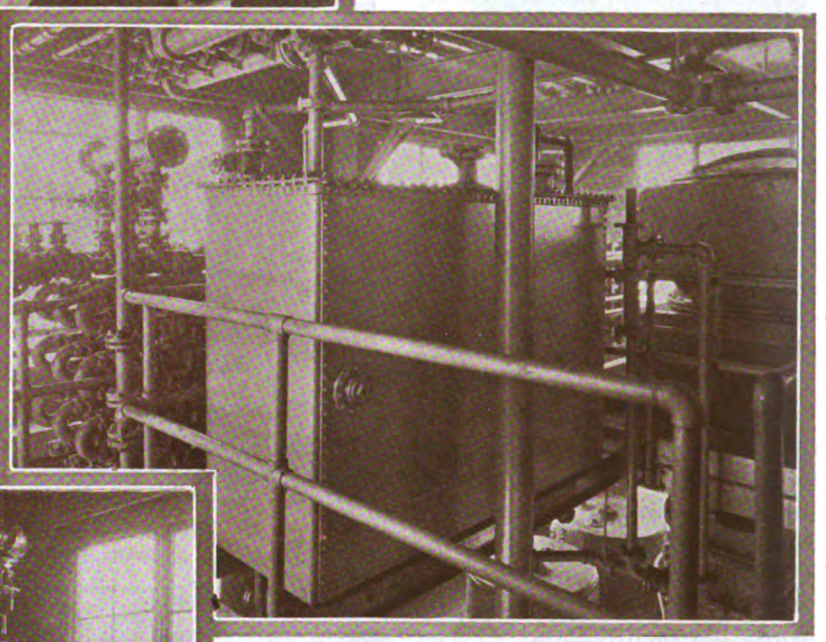
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(34) At the left—These are the pumps which handle the light oil after it has been condensed.

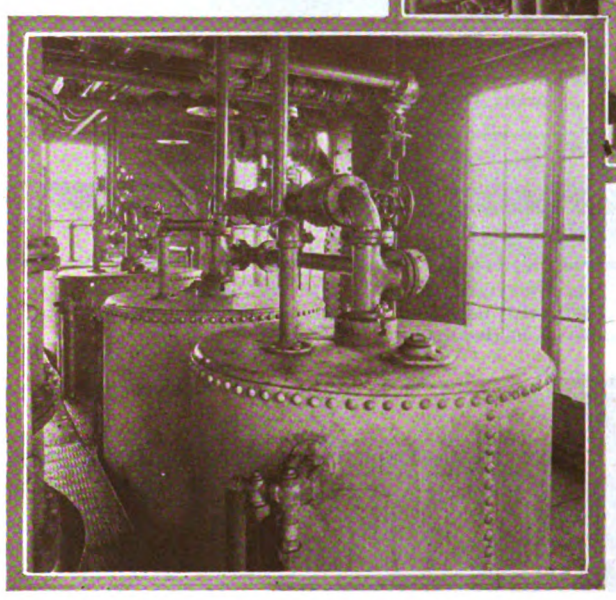
(33) At the left—The cooled straw oil, before recirculation, is decanted to remove the water it picked up in cooling. The oil is decanted in the decanter shown here, which is elevated above the circulation tank and "muck tank" on either side.



Ford operation and management.

So vast in extent and scope is River Rouge that we might fill all the pages of this issue from cover to cover with carefully selected illustrations with out fully covering our subject. When one visits this great plant, if he is to really see it and comprehend it, he must study it in sections and distribute his visits over several days at least. Otherwise his mind will become confused from seeing too much at once. On the same principle the reader's visit to River Rouge through the medium of *Industry Illustrated* must be in sec-

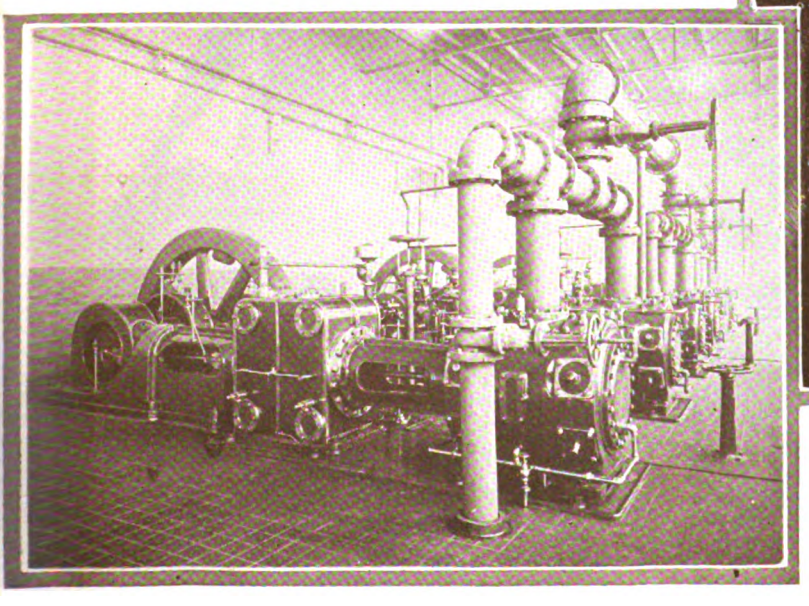
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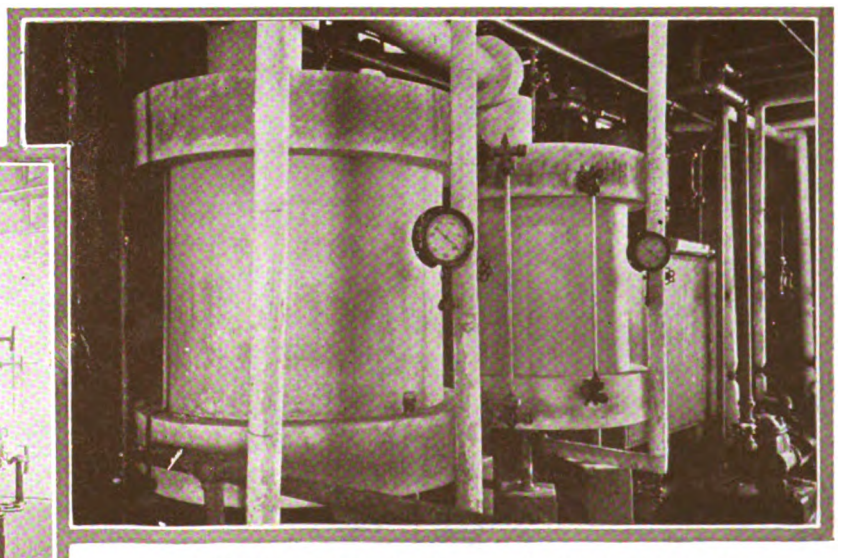


(35) Above—From the condensing coils shown at the left of the above picture the light oil goes to the separator (in the center) where it gives up its water.

(36) At the left—The light oil vapors, separated from straw oil in the stills, are passed through water condensing coils, then to a separator which removes the water, and the clean light oil passes to measuring tanks (shown here) and on to storage.

(38) Below—These compressors are employed for pumping the enriched illuminating gas to the municipal gas station, whence it goes into the city mains.





(37) Above—Illuminating gas is the last of the by-products obtained from the coal. About 87 percent of the gas produced at River Rouge is used in industrial heating processes within the plant. The surplus, after enriching with light oil vapors to the requisite candle-power and B. T. U. standard, is sold to the City of Detroit.

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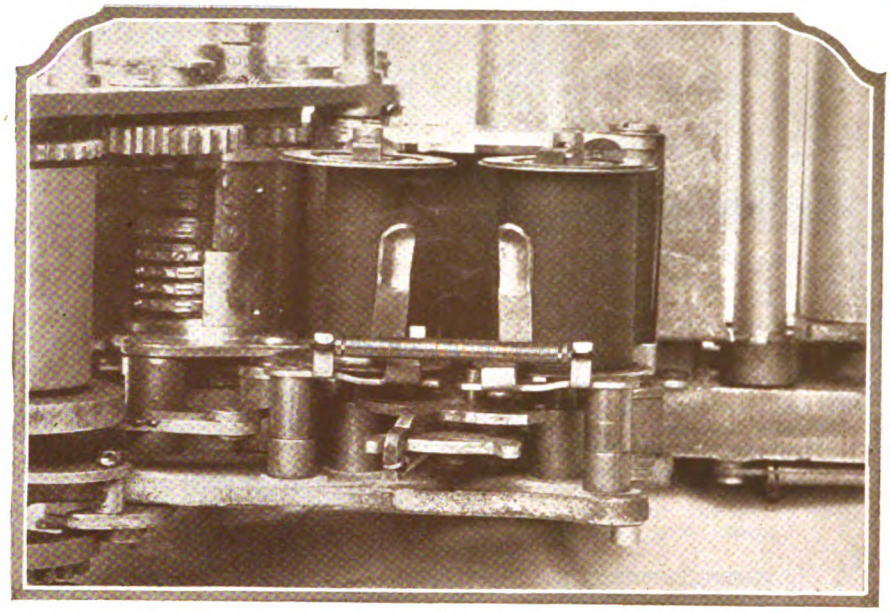
What Suggestion Systems Have Accomplished

Some Worthwhile Ideas Developed by the Rank and File

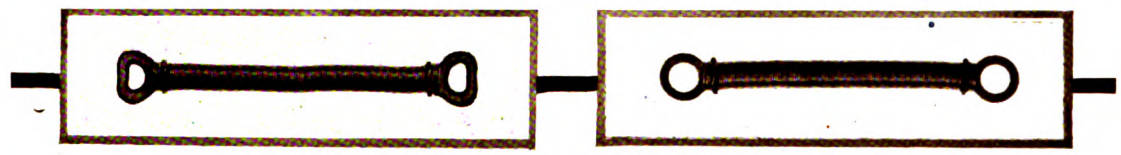
BY APPLETON STREET

I'VE read a lot in the industrial papers about suggestion systems," said a successful factory manager recently. "I've read about how to organize a suggestion system, how to equip it and carry it on; how to stimulate suggestions from timid employees; how reward suggestions, the relative value of cash prizes and other kinds; how to break the news tactfully to an unsuccessful suggestor; and so on. I think I know pretty well how to install a suggestion system.

"But what I haven't read in any of the papers is an account of the results. Oh, of course there is mention of some occasional improvement initiated in this way, and there is always talk of the intangible results—the stimulation of employee interest and good will. But what I should like to know is the tangible return in acceptable, workable suggestions. What sort of suggestions do employees make? What actual results have been accomplished through the offer of prizes for ideas? That, after all, is the question of first interest to a manager who is considering the introduction of a suggestion system into his plant.



Ribbon-reversing mechanism, showing the coil spring which had a tendency to slip off.



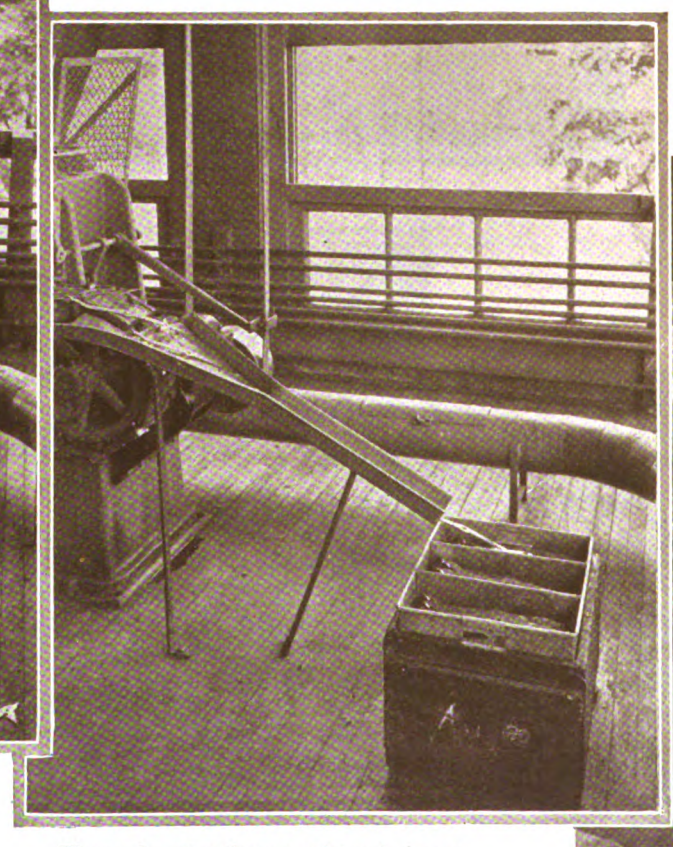
At the right the old style coil spring; at the left, the flattened eyes that cured the trouble in the mechanism shown at the top.

"In other words, while I know fairly well what a suggestion system is and how it is installed and operated, I'm not convinced yet that it is worthwhile."

This is a valid objection. No factory man is interested in a suggestion system for its own sake, but only for the results which it will bring. How to install a system is secondary to the question: Is it worth installing? And so, as a result of this chance objection, which



These register keys used to come from the polishing machine as shown here, after which they had to be laid straight by hand.

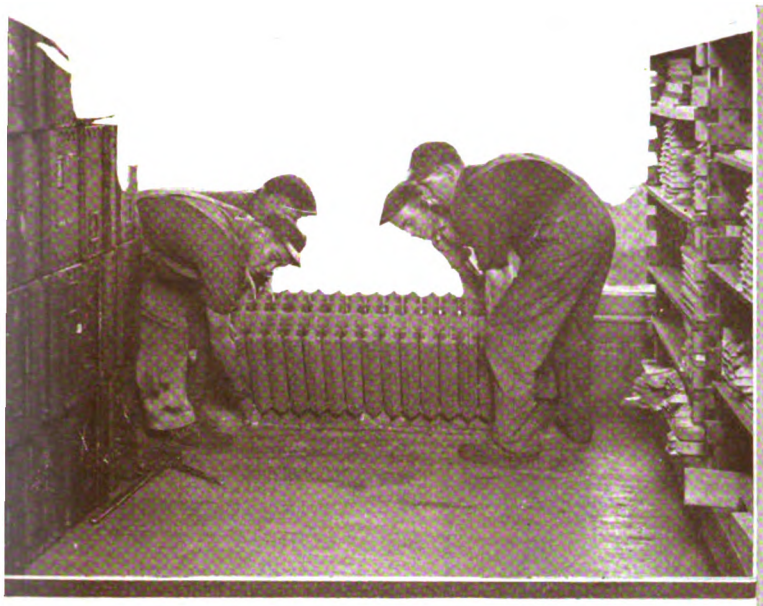


The only way these register keys can now go into the box, is by aligning themselves—saving the extra work.

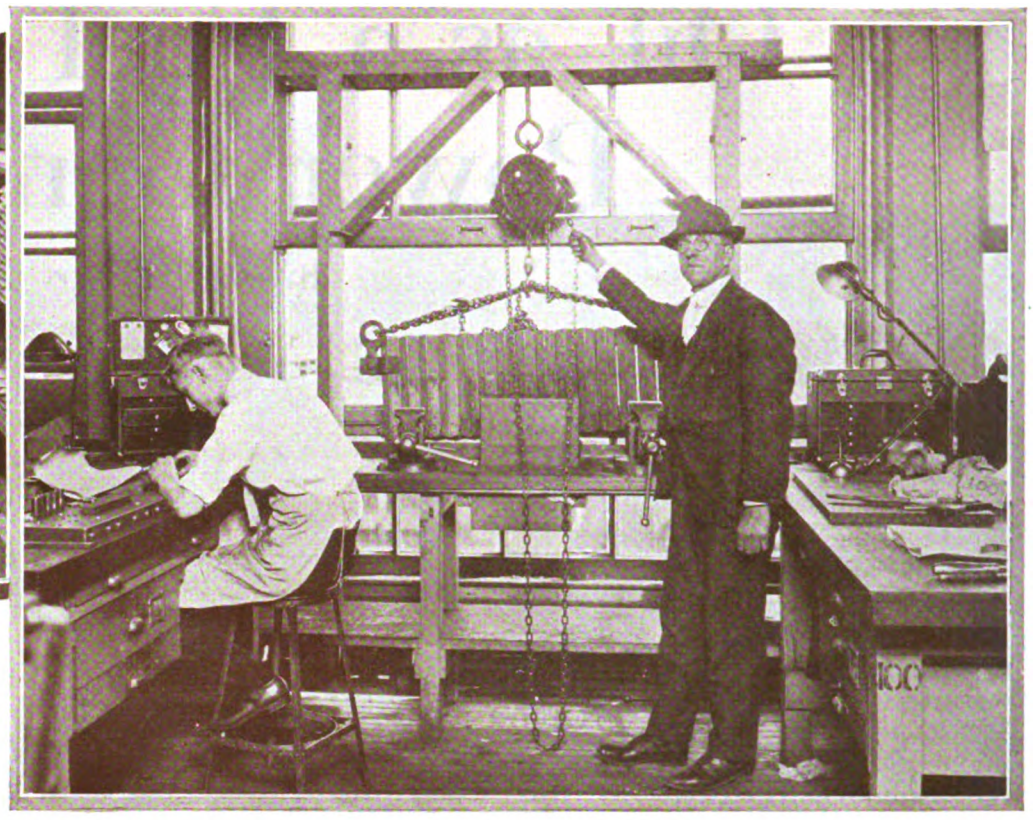


Below—When the box is full, the metal compartment box is removed; leaving the keys in orderly array.

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Four men and much disturbance of surrounding work, under the old method of repairing and re-packing radiators.



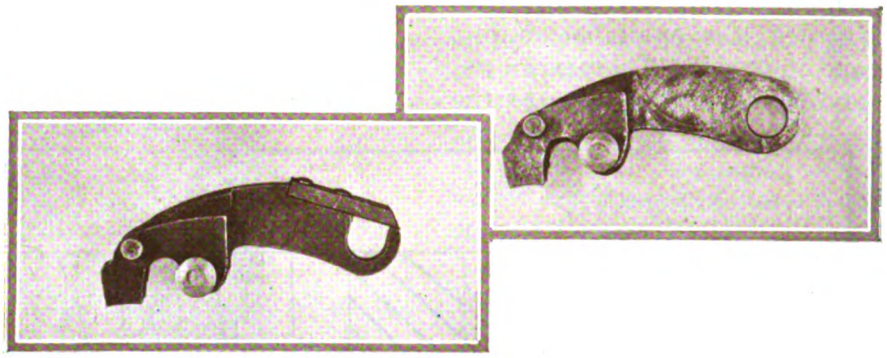
This simple rig and hoist enables one man to attend to radiator repairs, with a minimum of disturbance to work in the immediate vicinity.

we ran across in the course of an inquiry into the various types of suggestion systems, we are going to make this article entirely an account of results—a report of successful suggestions submitted by employees and put into practical use in the plant.

At the outset it is important to recognize the obvious limitations. A suggestion system will not turn the working force into a group of Watts, Stephensons, Whitneys, Edisons, and Westinghouses. Normally only a small percentage of the suggestions offered will be practicable, and of these only a fractional part will be of outstanding value. Too often a plant manager expects a suggestion system to work wonders and transform plodding workers into brilliant innovators, whereas all it can do is to stimulate latent initiative and get the workers to think constructively and in terms of improvement.

This thought of improvement at the beginning may take the most obvious and trivial forms. There will be suggestions reporting a leaky faucet in the washroom, a broken floor, a dirty window, or some other such fault. Some educa-

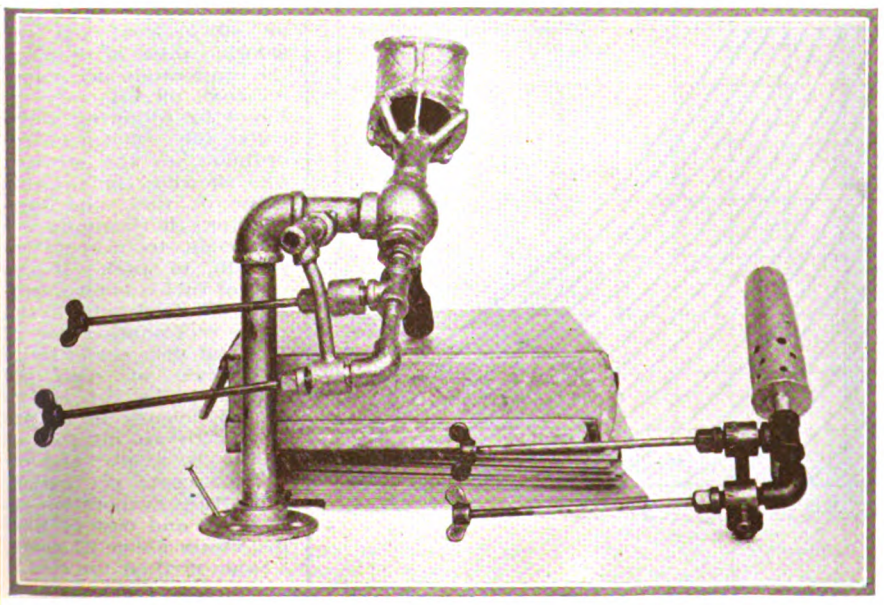
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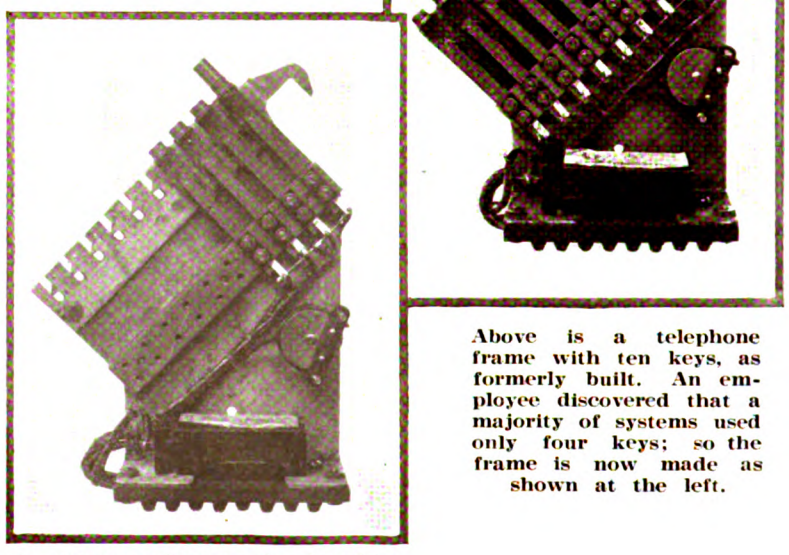


At the right, a switch lock lever which necessitated taking out cam line and retiming, when replacing lever. By making it as shown at the left, this trouble was done away with.



Above—an oil burner developed in a plant's own plumbing shop; used in heat treating.





Above is a telephone frame with ten keys, as formerly built. An employee discovered that a majority of systems used only four keys; so the frame is now made as shown at the left.

At the left—two more burners developed by employees at the same plant as cited above. These burners are used in various production departments and are both cheaper and better adapted to the work.

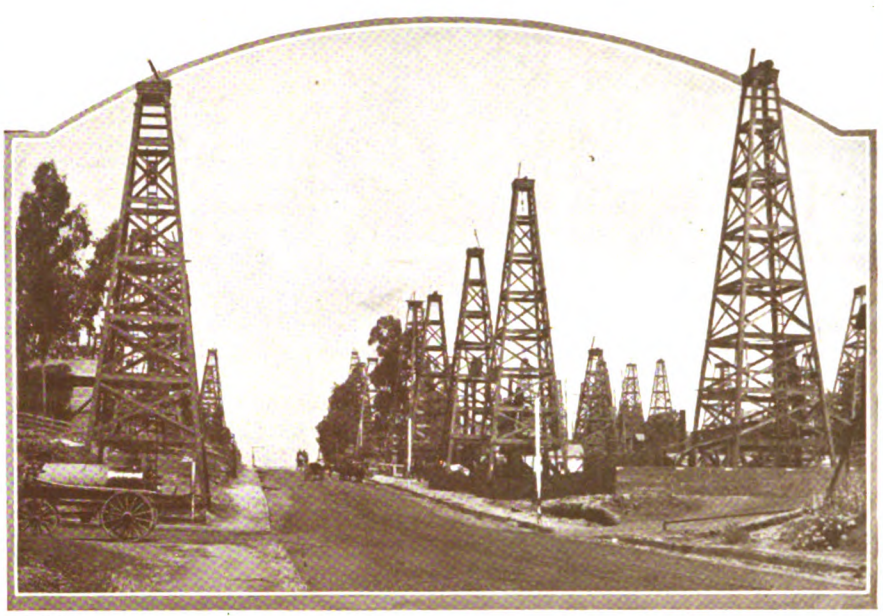
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Oil, as a Fuel for Steam Power Generation

By W. Thomson Lees

OIL fuel when compared with coal possesses one advantage that has not been stressed—it is not hampered by tradition and haphazard development to anything like the same degree as coal. Oil fuel came into the industrial field sufficiently late to benefit from the mistakes and experiments made with coal; there was less of the "cut and dry" and more of scientific and engineering knowledge in the very beginning. As a result, developments in oil burning have been extraordinarily rapid.

There is no question but what fuel oil would entirely supplant coal, except for two factors: the available supply, and the price. There is an unending controversy as to the former; some eminent authorities maintaining that our undeveloped oil resources are practically unlimited, while others, equally eminent, state that there isn't enough oil to last a century. In the light of past history on such matters, however, it would be well to take the pessimists' predictions with a grain of salt—especially when we consider the vast shale deposits, as yet practically untouched, and which require but applied inventive genius to make them yield their oil at a reasonable cost.



© Galloway

Scene in the oil fields of Southern California. Once oil is found, getting it to the surface doesn't involve going down after it, day by day.

The question of price has been a serious one. Oddly enough, it has been not so much a matter of *high* price as of *fluctuating* price. Whereas the price of coal though it has mounted, has been steady and predictable over a period of months, the price of fuel oil has varied within wide limits over a period of mere days. Nor has there been any assurance of a maximum limit on the price of fuel oil during a coming

COMPARATIVE COST OIL VS. COAL PER THOUSAND POUNDS OF STEAM.

Knowing efficiency under which plant is operating on oil or coal and the calorific value of the fuel the evaporation per pound of coal or oil may be found by following vertically the efficiency coordinate, to the straight line showing the calorific value of fuel, and then running horizontally to the right to evaporation per lb. of fuel. If the cost of fuel is known, continue the horizontal to the curve representing cost of fuel and then vertically to the scale of cost per thousand lbs. of steam. Ex.—Efficiency is 75 per cent with an oil fuel of 18,000 B. t. u's, and oil costs 3 cents per gallon then the evaporation is 13.9 lbs. and cost of 100 lbs. steam about 27 cents. Same method for coal.

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"Capping" a gusher in the modern way. This one was choked off in seven minutes; saving thousands of gallons of oil, which used to be wasted while a new well was brought under control.



(Courtesy of "The Lamp")

Installating a pipe line through the "wilds." The men are here cementing a section of the line.

twelve months or more. Obviously, this uncertainty has operated to discourage a number of interested power men from changing their plants over.

In the past, too, the executive in charge of the average industrial plant has had little detailed knowledge of power generation. It has been the general practice to consider the power plant as a separate domain—a more or less independent kingdom within the works, under complete charge of the power engineer. And only the more progressive of power engineers has kept abreast of recent developments; there are still a great many engineers in charge of power plants, who are so steeped in traditions that only an earthquake could shake them loose from their convictions—these convictions being that there never was, is not, and never will be anything but coal as a primary heat source for power generation. Only an awakened interest on the part of the man higher up, can force these men to see the light; and that awakened interest is beginning to make its appearance as a result of the closer scanning of balance-sheets which carry an ever-increasing charge for power.

It is easy enough to figure the evaporation secured from a given number of tons of coal, as compared to the evaporation obtained from a given number of barrels of fuel oil. It is easy to figure the brake-horsepower-hours for a specified quantity of fuel oil, as against the horsepower hours for specified amounts of a specific grade of coal. But these figures mean something only when we can convert them into



(Courtesy of "The Lamp")

At the right—Sectin of a completed pipe line. These lines run from oil well districts, often hundreds of miles, to the refineries, furnishing a cheap, rapid means of transporting the crude oil.



© Galloway

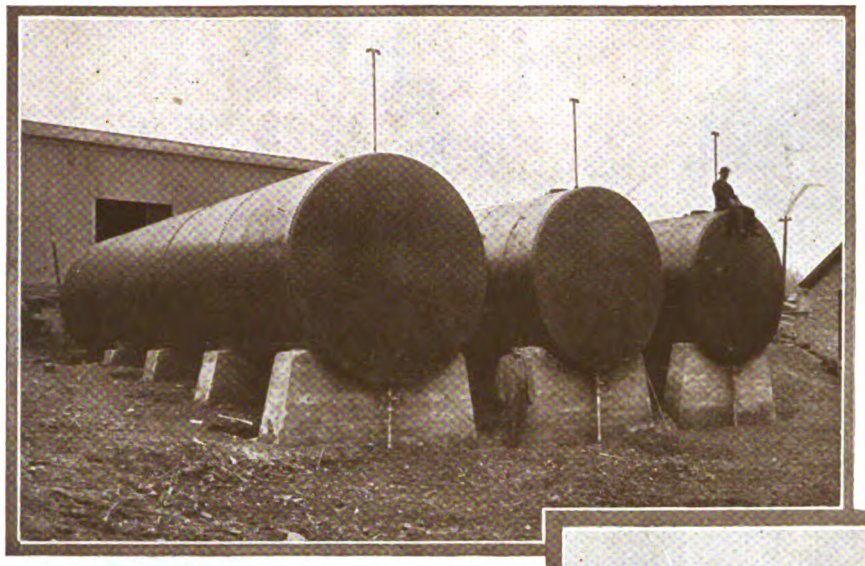
Typical tank cars, used to transport the oils from the refinery to consumer.



© Galloway

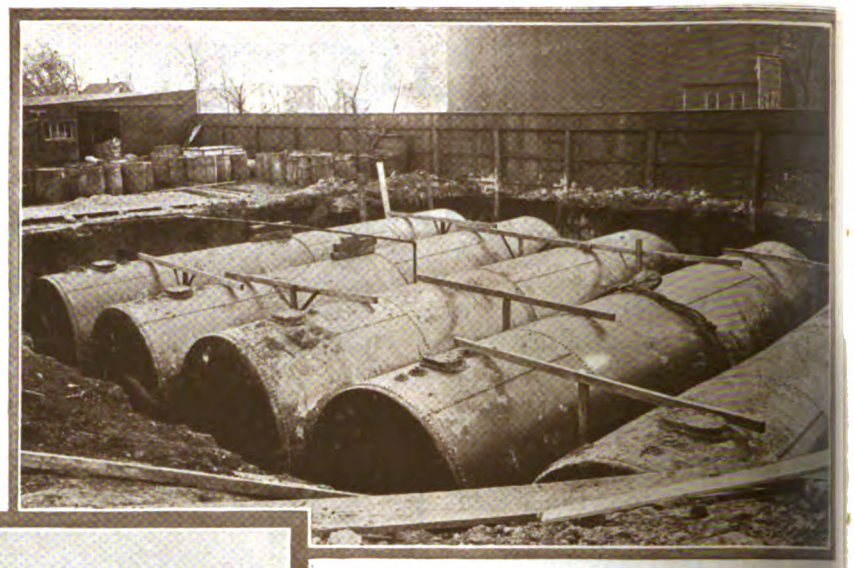
Loading ranks (Sinclair Oil Refinery, East Chicago) by means of which tank cars are filled expeditiously.

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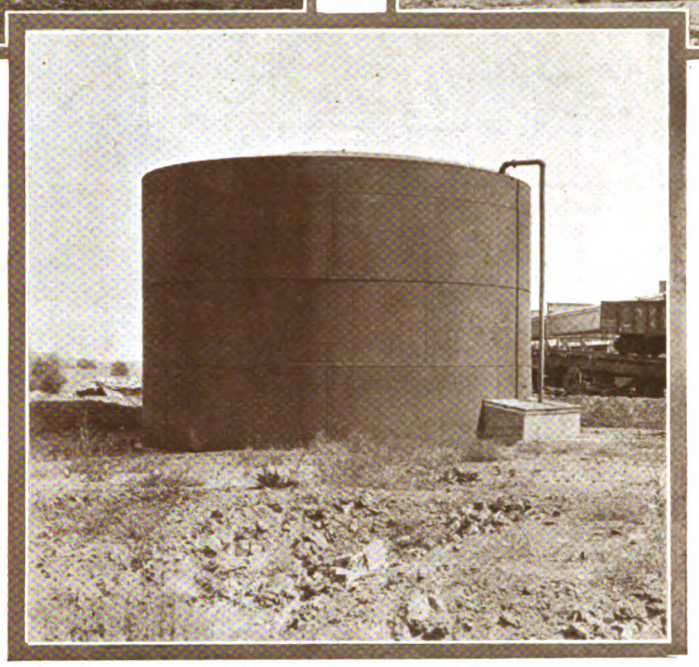
(Courtesy of S. F. Bowser & Co.)

Above-ground oil storage tanks. Similar installations are used at power plants where oil-fuel is burned.



(Courtesy of S. F. Bowser & Co.)

Underground storage, such as this, is a radically different proposition from the space-consuming coal yard or pocket.



(Courtesy of Wayne Tank & Pump Co.)

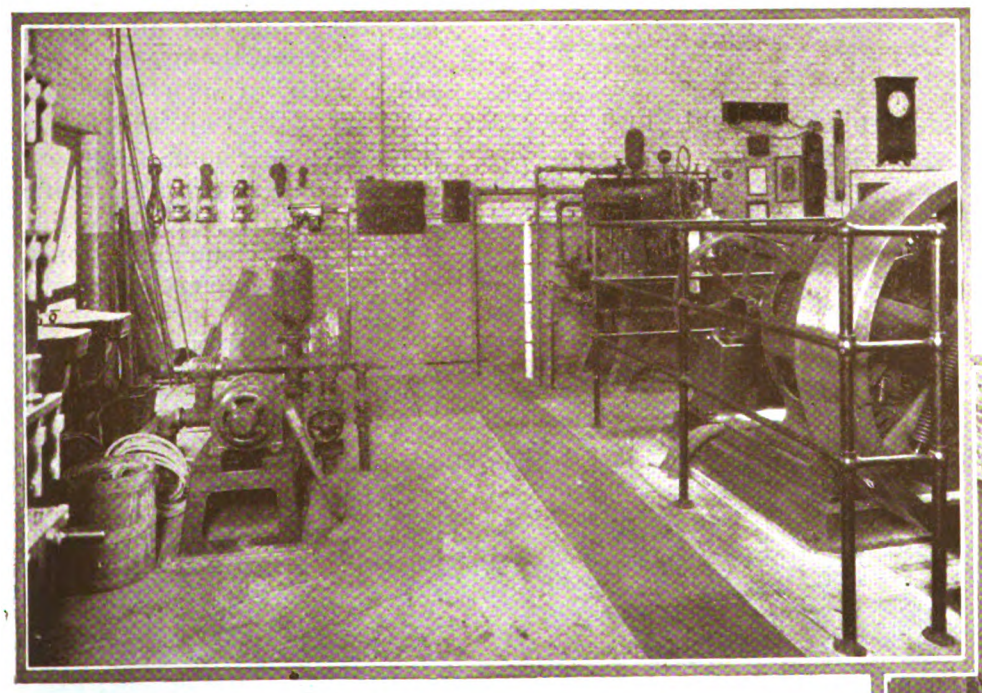
One hundred-thousand-gallon tank at the Moline Malleable Iron Co., St. Charles Ill. Oil is pumped from tank cars into this huge field tank, from which it goes to a 20,000 gallon underground storage tank; being pumped to the burners from there.

terms of cost. Abstract comparisons are well enough for the enthusiast and the experimenter, but what Industry needs — what the whole world needs—is *cheaper power*. If tomorrow we could produce power in unlimited quantities, at half the present cost, civilization would accomplish a century's growth overnight. Not merely industrial processes, but the whole social structure would be revolutionized for mankind's immeasurable benefit.

Fuel oil, in the present state of our knowledge, is not the answer to recurrent coal strikes, nor does it, right now, offer a universally applicable remedy for high coal prices. As stated in a previous article, there is no single, magic solution to what has been called our power crisis; but oil is *one* of the answers—of increasing importance, and capable of immediate application in a great many instances.

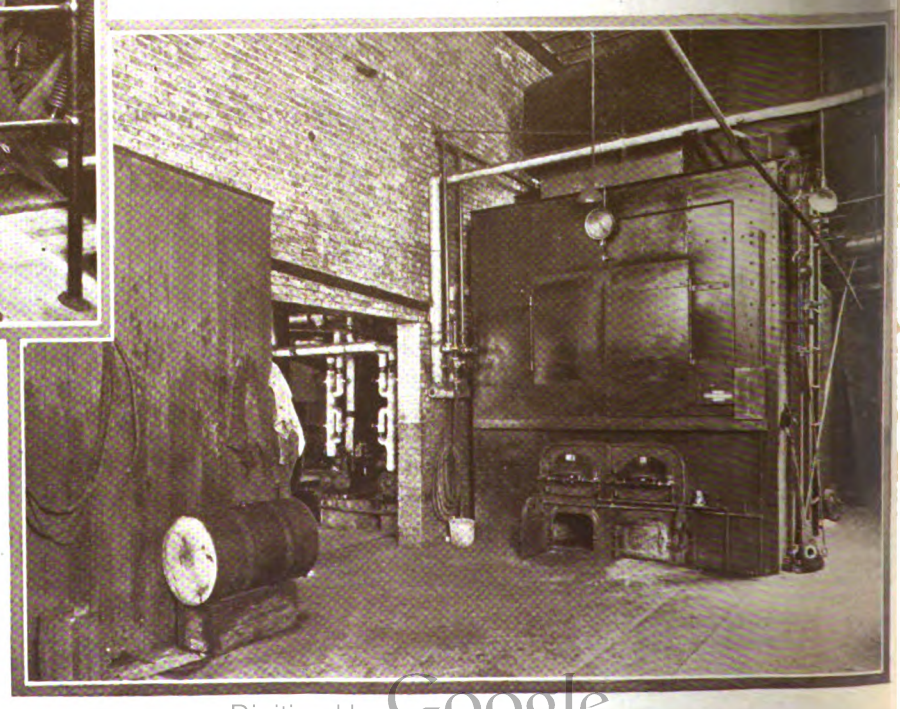
The automotive industry, from its start, has been one of the most progressive of modern industries; yet, even with its progressive ideals and far-sighted men, it took this industry a long time to strike out away from the traditions inherited from its ancestor—the carriage makers. Some of the first automobiles actually had whip-sockets on the dashboard —not because they were of any use, but because pleasure vehicles had always been made that way. Ridiculous as that idea seems today, it is no more ridiculous than a great many

(Continued on Page 48)



(Photos, Courtesy of Wayne Tank & Pump Co.)

Motor-driven impeller type pump which handles the oil for the installation at the Moline Malleable Iron Company. All pipes are in covered trenches.



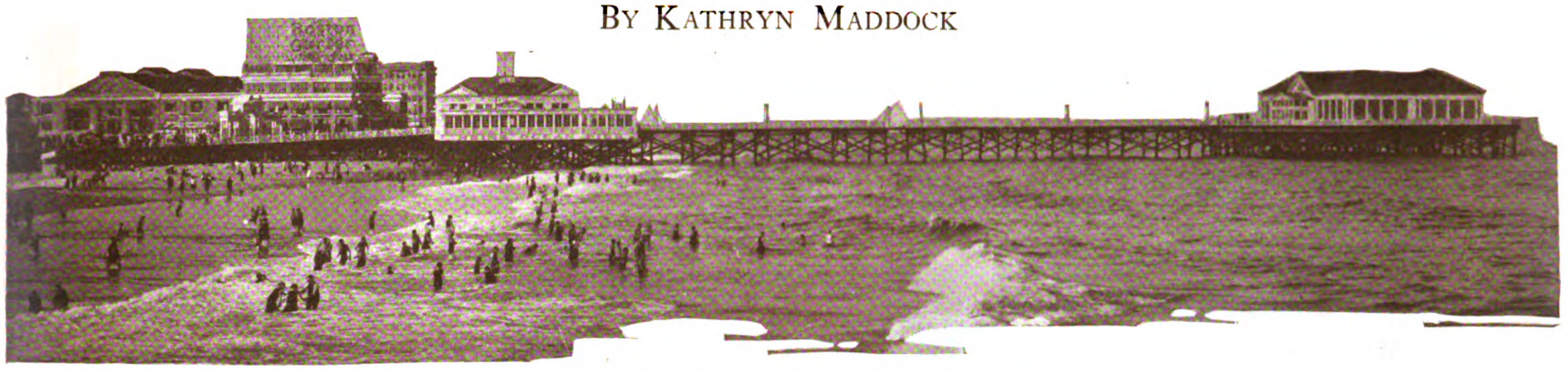
One of boilers at the Moline plant, showing piping from trench to burners under the boiler.

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Oblique Methods Bring Orders

The Value of Displays that Do Not Attempt to Sell

By Kathryn Maddock



Heinz started "oblique selling" at Atlantic City thirty-five years ago, with one building which has since grown into a pier. Six thousand pickle customers flock there each day at the height of the season.



Just because they aren't expected to buy in this handsome shop, the perverse public gives it thousands of dollars worth of business every year.

HIS selling equipment is not extensive, but he does have a baseball scoreboard to bring pennies his way, does Izzy, the little newsboy of capacious lungs who holds forth at the corner of the Plain Dealer building in Cleveland. He started it one day by scrawling the results, inning by inning, with a piece of chalk on the corner of the big granite building. It made a hit with the crowd that roots for Tris Speaker; he repeated it the next day, and the next, and the Plain Dealer folk, recognizing that it was a good newsboy venture, contrived him a sure enough bulletin board, with stylish lettering by a member of the art department, "Izzy Adler's Score Board," to take the curse of the chalk scrawls from off their good-looking building. Izzy says it pays.

Which is just another

(*Continued on Page 28*)



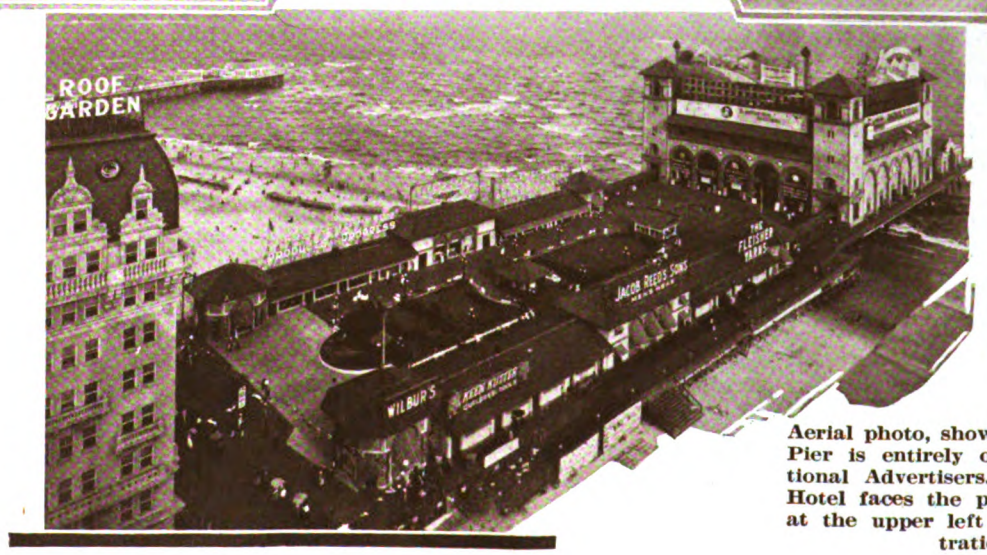
There is no cash register in this shop, which nevertheless brings in rich returns to the Dupont Companies and to manufacturers who use their goods.



Here the crowd stops to watch a cigar-maker at work, and hear him explain the process.



The newsboy with a baseball score-board sells more papers than his competitor with none.

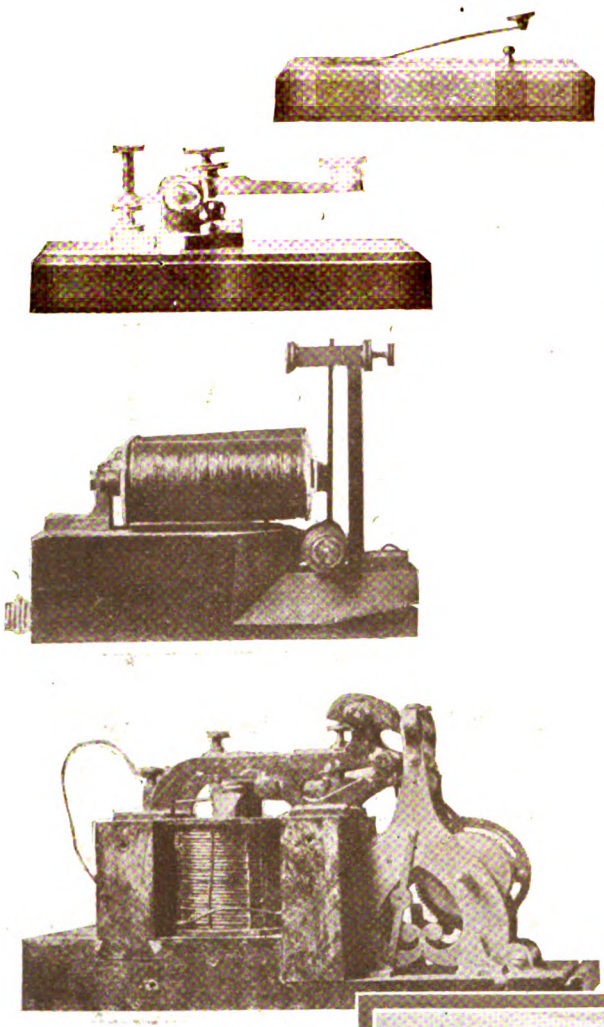


Aerial photo, showing how Garden Pier is entirely occupied by National Advertisers. The Breakers Hotel faces the pier. Heinz Pier at the upper left corner of illustration.

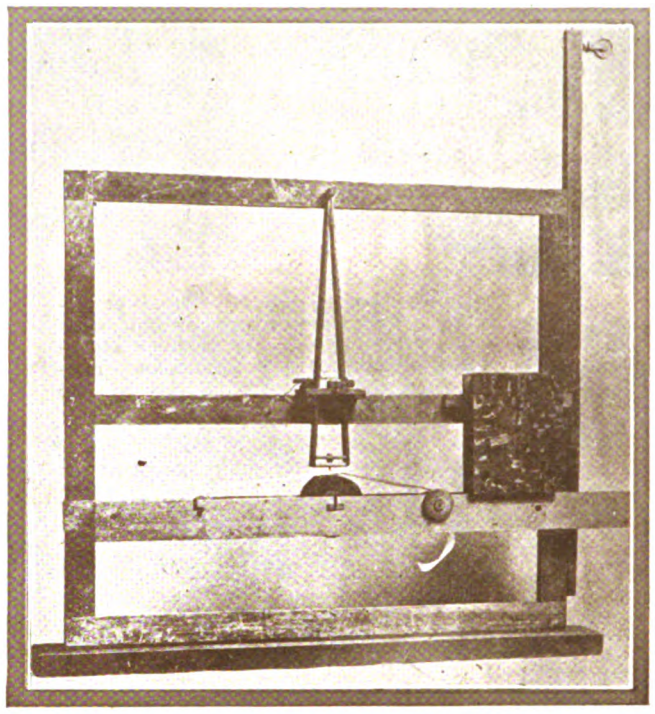
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The Modern Telegraph--Its Methods and Operations

By H. W. Rustin



At the left are shown, in order: Early type of key, improved key, early form of relay—and the first Washington to Baltimore instrument.



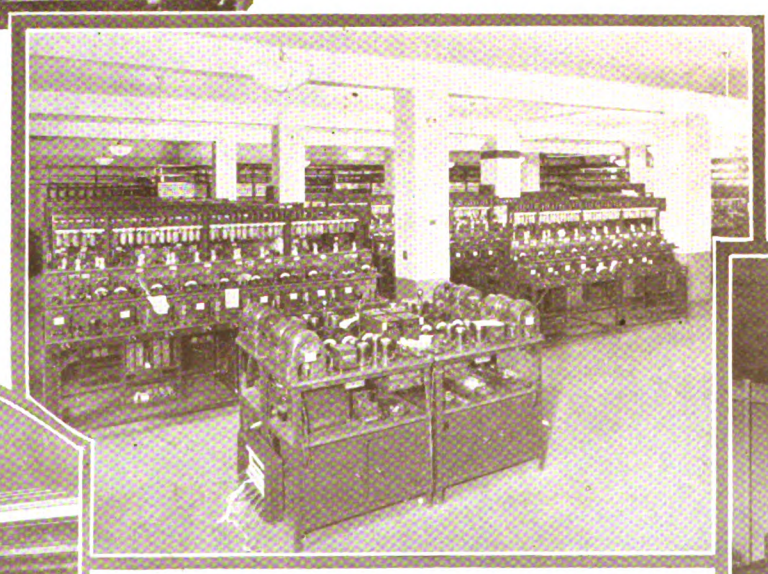
First telegraph instrument (1837) now in the National Museum in Washington. Its method of recording was comparatively simple. A pen attached to a pendulum, actuated by an electro-magnet, reproduced a series of long and short lines on a strip of paper.

SINCE the first practical demonstration of the telegraph by Samuel Morse in 1837 innumerable improvements have been made—but fundamentally the telegraph has not been changed.

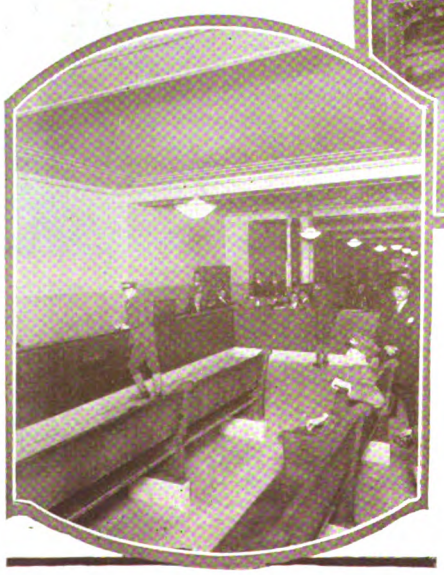
As early as 1832 Professor Henry had invented a bell-telegraph, providing for the recording of messages by sound. The receiving apparatus was exceedingly simple, consisting of an electro-magnet the armature of which struck a bell.

Morse's invention superseded this and his first instrument, used on the Baltimore-Washington telegraph line, was self-recording, having a pen attached to a pendulum that was actuated by an electro-magnet and producing a series of long and short lines on a strip of paper. This was the Morse dot and dash code, which has remained in use ever since. About the year 1850 the form of the recorder was modified and the operators learned to take down the dots and dashes from the receiving instrument by ear, which is the present method of receiving messages sent in the Morse code by key and sounder.

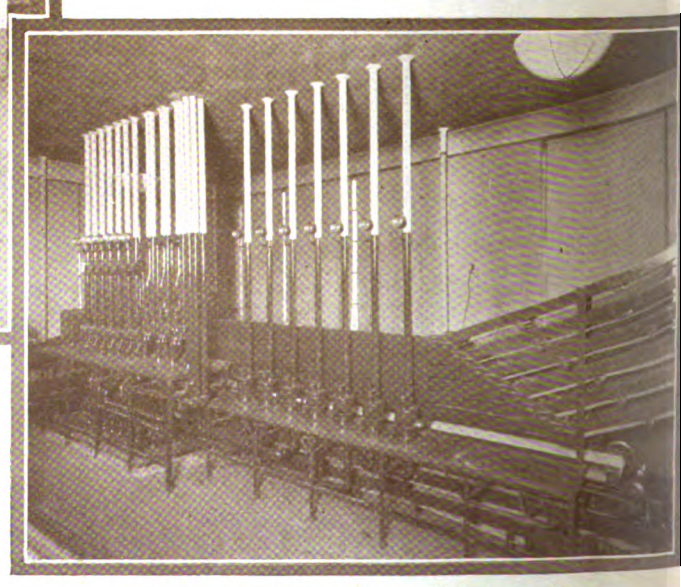
As the telegraph came into more general use numerous perplexing problems presented themselves—problems that re-



In the foreground can be seen the Rotary Repeater. In the background the Duplex Terminal used by testing and regulating attendants for the purpose of "lining up" duplex circuits.

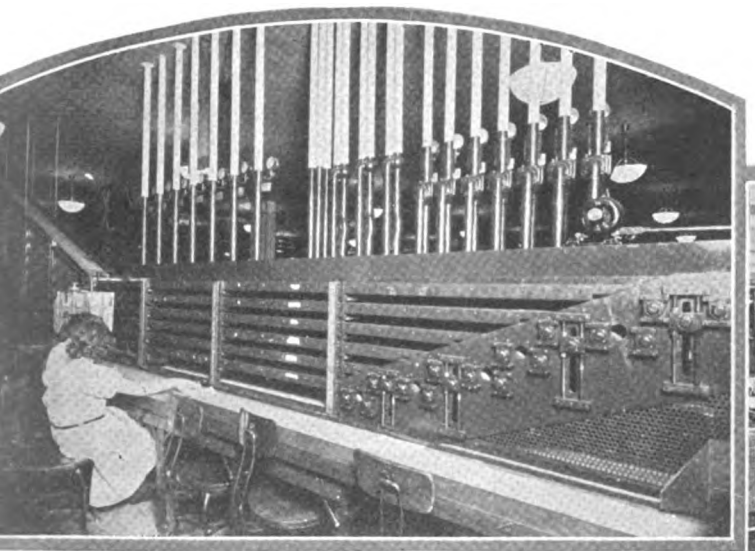


Messengers waiting to be dispatched for the pickup and delivery of telegrams.

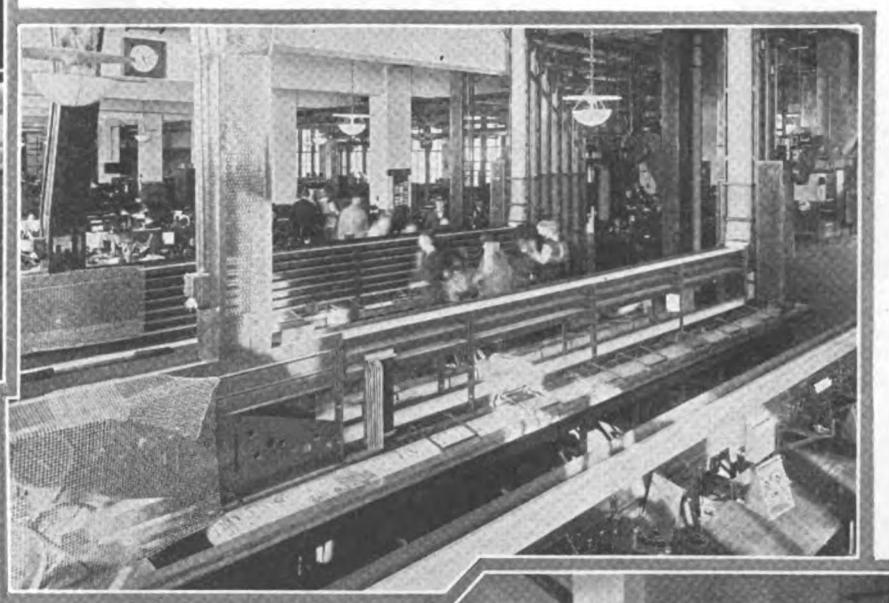


Pneumatic tubes (Front view) at the Distributing Center. The messages are removed from the tube carriers by attendants and belted to their proper destination.

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Above—Pneumatic tubes (rear view). The messages are removed from the conveying belt and routed and placed on one of the belts marked as A, B. C, etc.



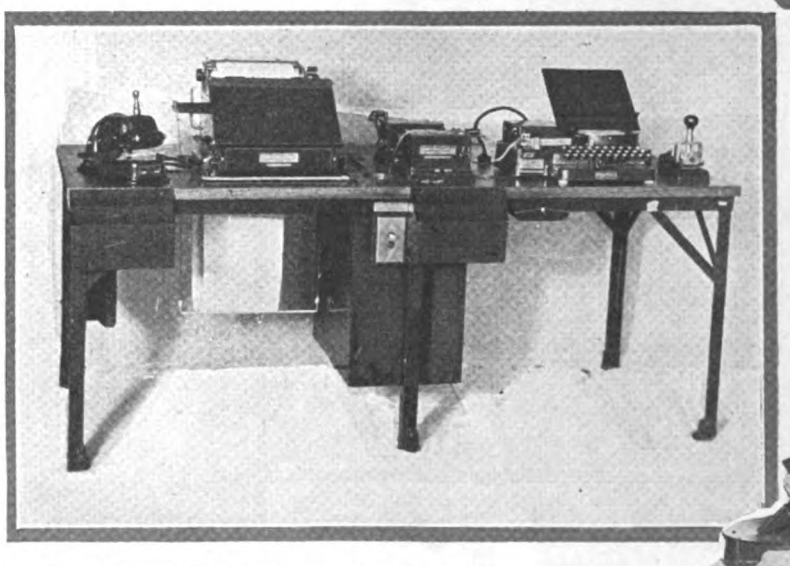
Distributing Center in the Chicago Main Office.



A closer view of the Multiplex sending apparatus—showing the perforator, the tape before and after the holes have been punched, and the mechanically-driven automatic transmitter.



Checking messages as they pass on belt conveyor.



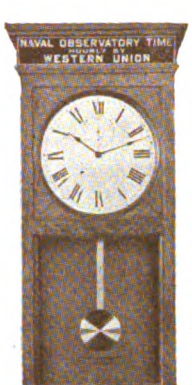
Receiving and Sending apparatus of the Multiplex. On the right is the sending, showing the serial number stamp, a perforator and automatic transmitter. On the left the receiving with the Multiplex printer and Stromberg time and date stamp. Note the manner in which the blanks are fed from the continuous roll into the printer.



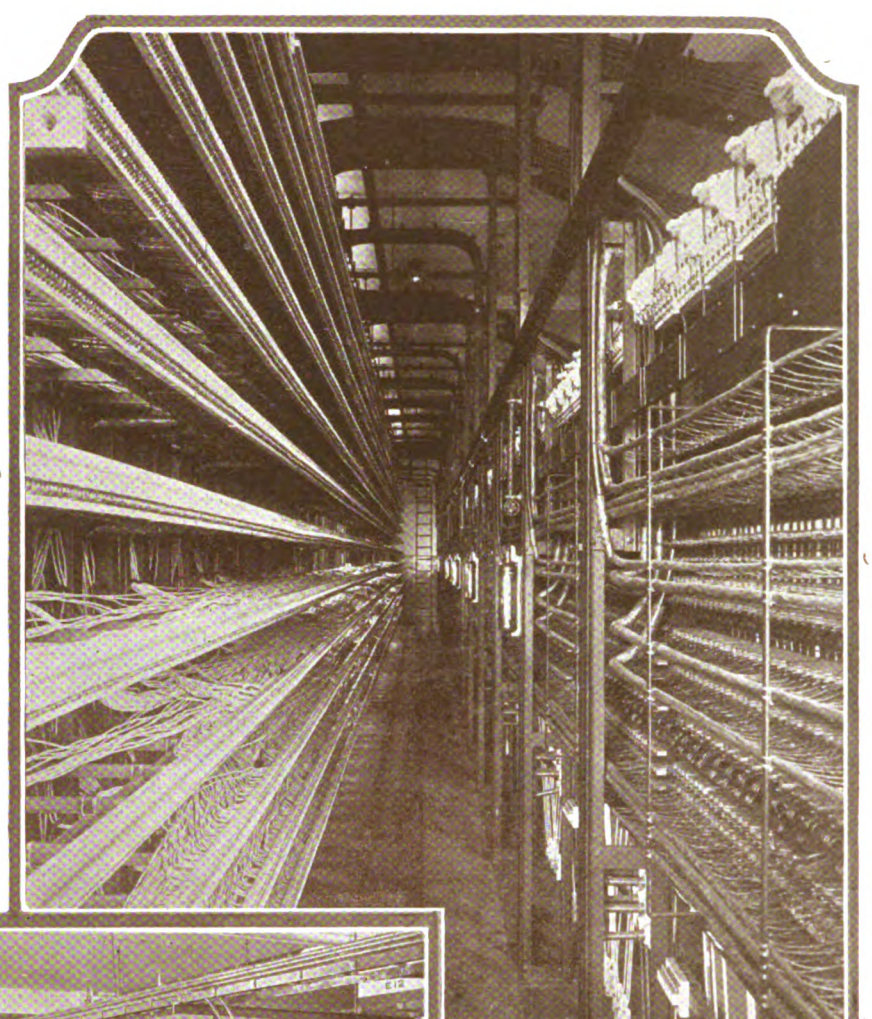
Comparing the tape with the message. Operator sending on the Multiplex.

uired a solution if the tele-
raph was to be a success com-
iercially. The world's finest
inds have bent themselves to
ope with these and by a slow,
tep-by-step process eventual-
accomplished their purpose.
By the telegraph as invented
y Morse only a single message
ould be sent over the wire at
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usiness increased, it was seen
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on of duplex operation, and
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ivented by Thomas A. Edison.
he duplex permits two mes-
ages to go over the wire in
pposite directions at the same
me, and quadruplex, the pass-
ig of four messages going si-
ultaneously over the same
ne, two in each direction.
Still further progress was
iade through the development
f automatic transmitting and
ecording apparatus. The
ost recent and efficient inven-
ion of this kind is the Multi-
lex Printer System, which
ermits four operators to re-
eive and four to send on each
ire at the same time, thus in-
reasing the capacity of the
elegraph line eight-fold.
The simultaneous transmis-
ion of eight messages over the

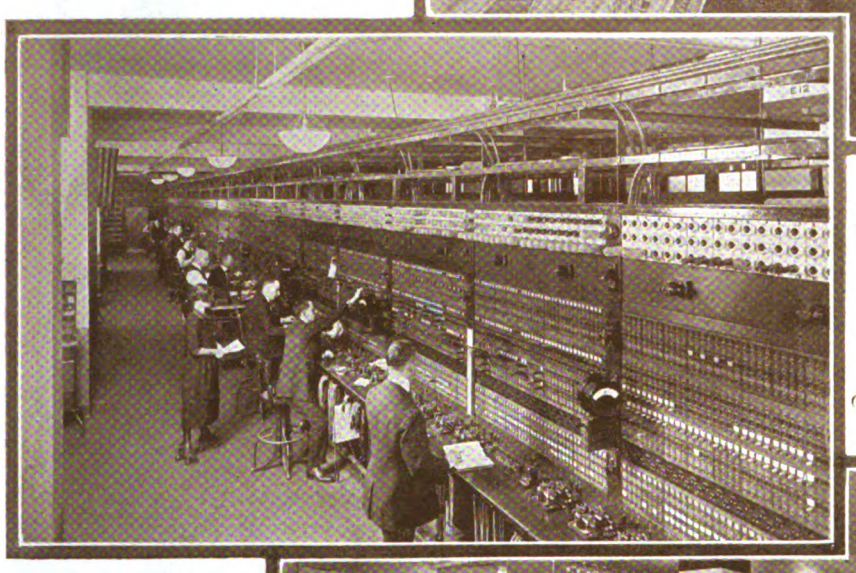
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One of the standard types of clock used in furnishing Western Union Time Service.



Rear view of the switchboard in the New York main office—one of the busiest in the world.



Front view of the same switchboard is shown here at the left.



Testing room, where lines are tested by delicate instruments to locate breaks.



A typical repair gang. These are the men whose real job follows any severe storm.

A four-car camp outfit for repair gangs—Sleeper, Utility Car, Diner, and Tool Car.



same wire is made possible by apparatus, the principle of which can briefly be described as follows:

At each end of the line are two disks, that are divided into groups of segments insulated from each other. Each group of segments is connected to one of the sending and receiving machines. A rotating contact brush attached to the line wire passes over the disk and acts as a connection between it and the individual channels. The brushes at the opposite ends of the wire act in perfect unison as to position and time. What actually happens is that each receiving and sending set gets the use of the line for a minute fraction of a second in rotation.

The Multiplex Printer was an important factor in coping with the unprecedented expansion of traffic during and following the World War.

To maintain its wire system in constant working order and to make quick repairs in case of storm damage, the Western Union Telegraph Company maintains a mobile force of gangs, plant and equipment men. These are divided into floating units consisting of a foreman, from twelve to twenty men, cooks, and a camp train consisting of a tool car, utility car, diner and sleeper. In cases of emergency these gangs, with their equipment, are ready at a moment's notice to be hurried to the place where they are needed, sometimes to another district where

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trouble has arisen requiring more than the local force.

Modern industry is responsible for the great telegraph system that binds and links together the business of today. Fifty yars ago scores of small, privately-owned telegraph companies, charging high tolls and giving poor service, were in operation. In 1856 Hiram Sibley began the process of amalgamation by which these companies eventually were consolidated into the organization called the Western Union Telegraph Company. Today it has grown into one of the World's largest corporations. This Company employs over 60,000 people and operates some 26,000 offices. Its annual disbursement runs well over $90,000,000, approximately $68,000,000 of this being spent for the salaries of employees. It has been estimated that the copper wire in its lines if placed in one great coil would encircle the earth some 63 times.

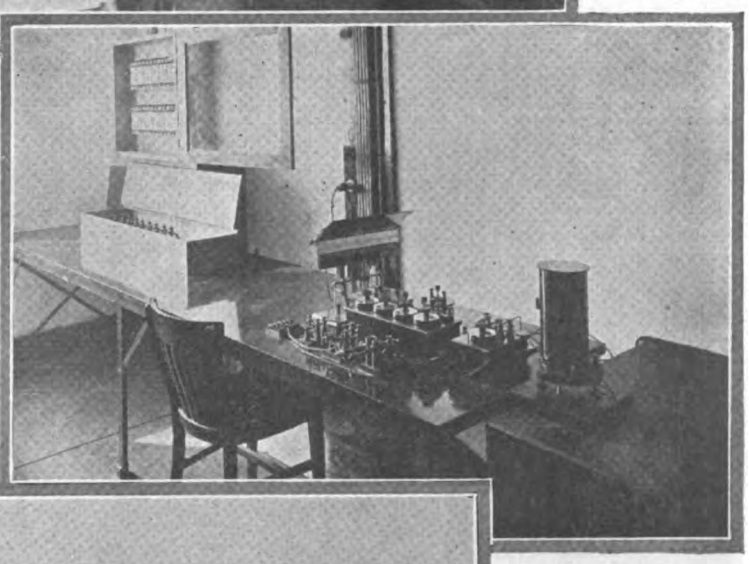
That the Telegraph Company today is a great corporation is true, but it is a corporation that keeps in personal touch with its employees, knowing that the element of human interest is a vital one. Its policy is one of coöperation and each and every employee in all its departments is working with one definite aim—for the elimination of the wasted second and to "Get the Message Through."

It may be interesting to trace the actual course of a single telegram—from the time it is handed to the messenger

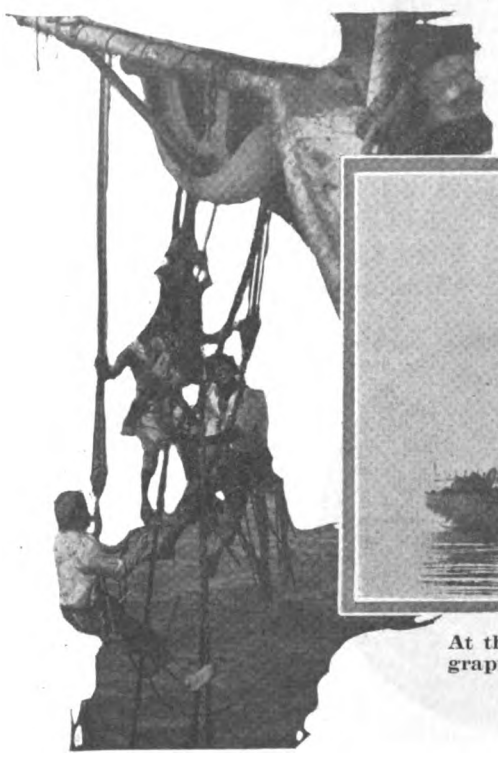
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Part of the cable operating room at New York, where transatlantic messages are handled.



Cable testing instruments, for locating breaks, etc. By resistance-measuring, the break can be located within a few feet.



At the left—Picking up a cable by grapnel from the ocean's bottom.



The Cable ship "Lord Kelvin" is shown in the center panel.



At the left—Picking up a buoy which has been attached to cable.



At the left—The complicated gear for picking up cable at sea.



Below—"Laying in" sheathing wires over a newly spliced break in a cable.

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The Making of Watch Crystals

By W. H.



Glass Blowing Room. Furnace in left upper corner is the melting furnace; directly in front, a glass blower is seated on a bench forming a globe from which the crystals are cut. Furnace on right is where pots are preheated. A rack for holding the blown globes is shown on the floor at the right, containing several globes.



Cutting Room. The globes from which the crystals are cut are shown on the center cutting table. The globes shown are split in halves previous to cutting out the crystals.



A blown globe from which the crystals are cut. The photograph shows the high polish this globe takes from the fire.

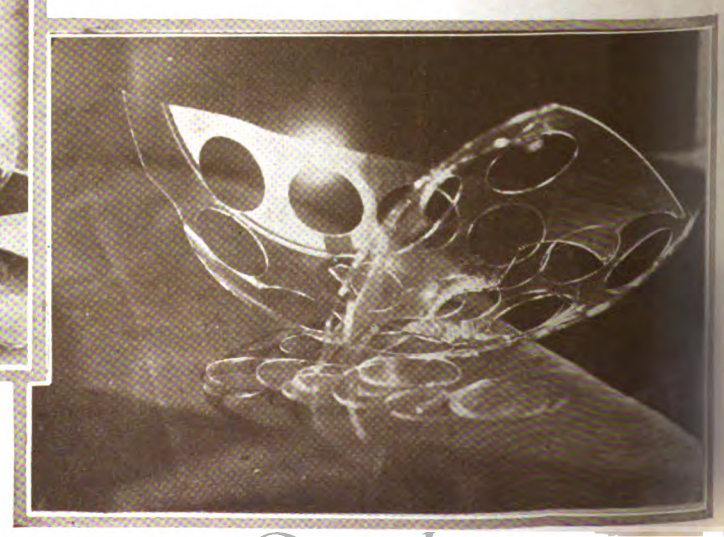


Cutting out the crystals from the globe sections.

At the outbreak of the war American watch manufacturers imported their watch crystals from Germany, France, Austria, Belgium, and Switzerland. The shutting off of imports found the watch industry of the United States in a bad position. Millions of dollars invested in watch plants, watchcase concerns, and the watch trade in general; thousands of workers in the manufacturing and jobbing trade; all affected by the lack of a small piece of clear glass that costs at the most a few cents. There was nothing that could take its place and there were none being made outside of the countries mentioned. It was up to the American watch manufacturers to either make the necessary crystals themselves or else tie up their plants until imports were resumed.

As a consequence several attempts were made to manufacture them on a commercial scale. They were unsuccessful. At this period, the Waterbury Clock Company, probably one of the largest users of watch crystals in the world, decided that they could and would manufacture watch crystals.

It was vitally necessary that these small circles of clear colorless glass, accurate, highly polished and free from all blemishes, should be manufactured in quantities and at a reasonable price. The first Ingersoll Watch carried a crystal made from a piece of common window glass, cut round and ground by hand. It is a far cry from that crystal to the



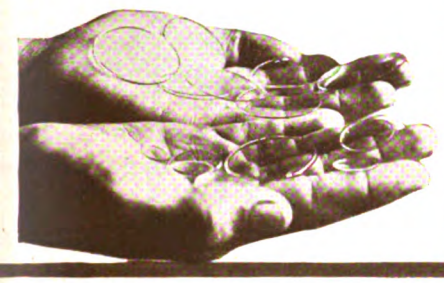
At the right—Sections of a half globe, showing crystals cut from them.

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Now An American Art

HOLMES

The American Watch Industry, employing thousands of hands, and representing millions of dollars of invested capital, is dependent upon a small piece of glass costing a few cents to manufacture.

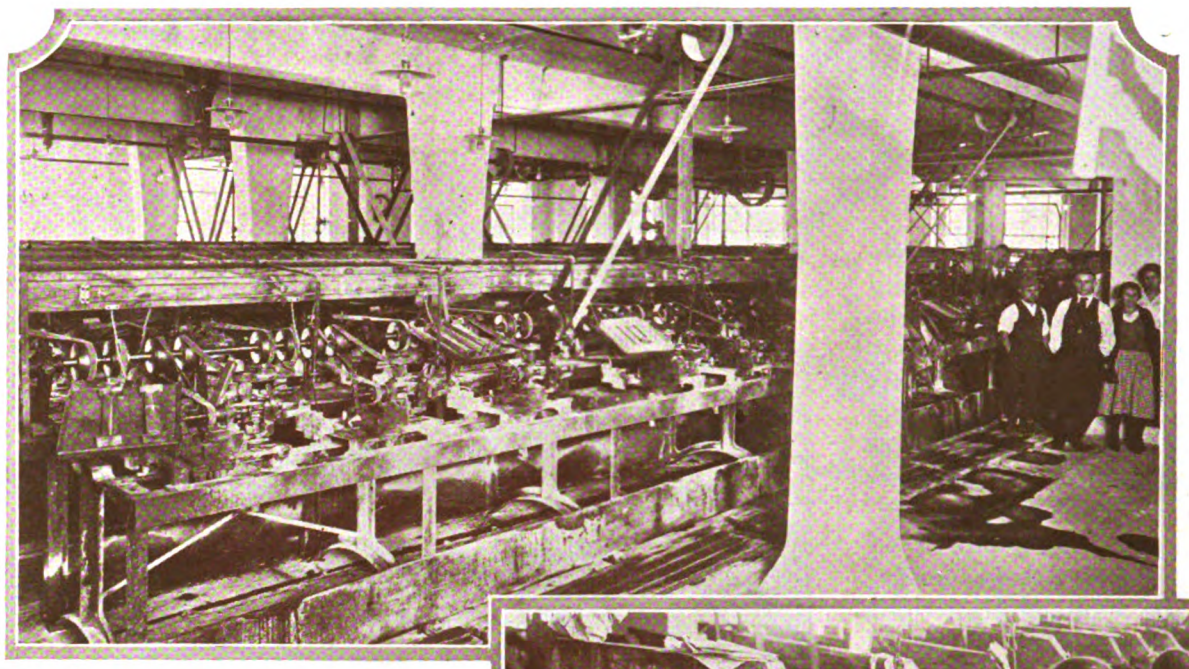


fine, perfectly formed crystals that are used on high grade watches today. One might say that the latter are as finely finished as a lens. To make these crystals was the task the Waterbury Clock Company undertook.

With their own needs in view and backed by the hopes of the industry in general they started this new industry. Without previous experience in this line, and handicapped by a lack of skilled help or the necessary machines, the concern succeeded in placing the manufacture of watch crystals on a sound commercial footing. This concern is practically the only one in the United States that is making crystals. It is producing goods that are fully equal to the imported goods, and is supplying other watch and watch-case manufacturers in addition to its own enormous wants. The success of this particular plant has made the United States practically independent of foreign countries for watch crystals, so far as the manufacturing is concerned. During the war, in a period when experimenting and "learning how" was the order of the day in this new industry, they supplied some 50,000,000 crystals to the trade.

However, the accomplishment was not without its obstacles. It took the Company several years, from a start where hand labor was employed almost exclusively for lack

(Continued on Page 54)



Crystal Grinding Machines. Miconcave crystals, which are crystals cut from the half sections of the blown globes without further forming, are ground on this type of machine. The grinding brings them to correct diameter and forms the bevel on the edge.



Grinding Lentille Crystals. Boxes at left show method of handling the crystals.

Inspecting; gauging crystals for thickness, on the right.





The only watch crystal plant in The United States. Previous to the war all watch crystals were imported. This plant has a capacity of 800 gross of watch crystals a day, of all designs and sizes used in the trade.



Hand polishing and inspecting. Cabinets in back show method of stock keeping.

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Music as an Aid to Industrial Teamwork

By B. S. Beach

AMONG the "by-products" of American industry, music must be given a prominent place.

A survey just made of half a dozen prominent big plants shows that along with the legitimate products of those establishments — machinery, tools, implements, goods of all kinds—there has also been given to the public in various ways a noteworthy array of bands, orchestras and choruses.

The industrial worker is frequently also a choral singer who needs only a little training to blossom into a creditable amateur; and he is now getting that training right in the plant where he is employed. Or he may be a versatile musician, fond of enlivening an hour or two of leisure in an informal program with other performers who do not stop to put off their overalls before taking up their instruments.

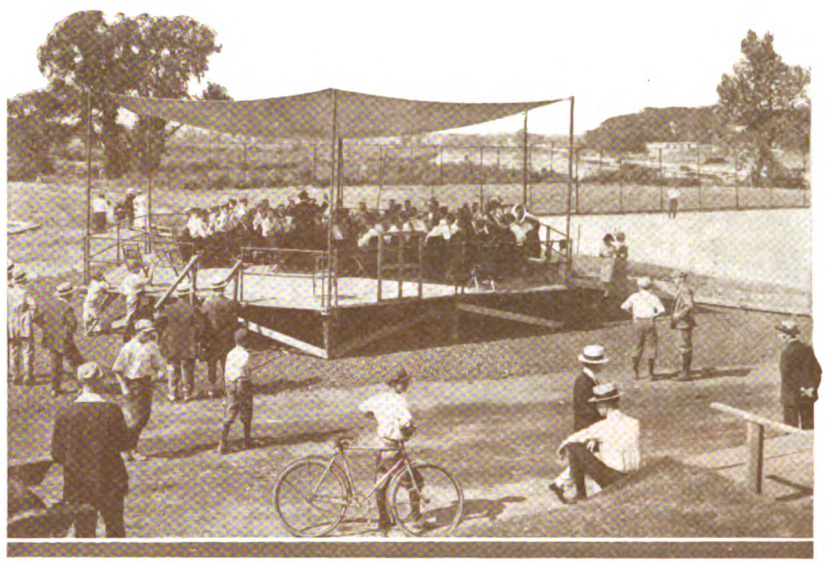
The case is even on record of a shop worker in a Pittsfield plant who has composed a "brass pipe quickstep." It is written, according to the score, in the key of "pipes"; and those who have heard it say it is a harmonious echo of the purr and whine of great machines in a modern factory.

Aside from the freakish element, however, there is a surprisingly well-developed musical undercurrent in the life of some of the best known industrial organizations, from which the public is gaining the benefit.

Citizens of Lawrence, Mass., were entertained through an entire summer by a complete brass band, composed of employees of the American Woolen Company. This band offered its services to the city, without charge or fee, and gave an acceptable program of concerts in the city parks.

They have a chorus of 200 voices at the plant of the National Cash Register Company at Dayton, O., which has given concerts at the Miami Valley Chautauqua entertainments before audiences of 2500 people; and the Stetson Chorus, of the John B. Stetson Company of Philadelphia, sings annually at the Christmas exercises at the Stetson plant to

(Continued on Page 30)



General Electric Company Band.

Below—Burgey's Orchestra. Industrial employees with musical talent form organizations of their own and play for both pleasure and profit.





Noon hour entertainment in a big factory yard to the accompaniment of a full band with the audience joining in the chorus.

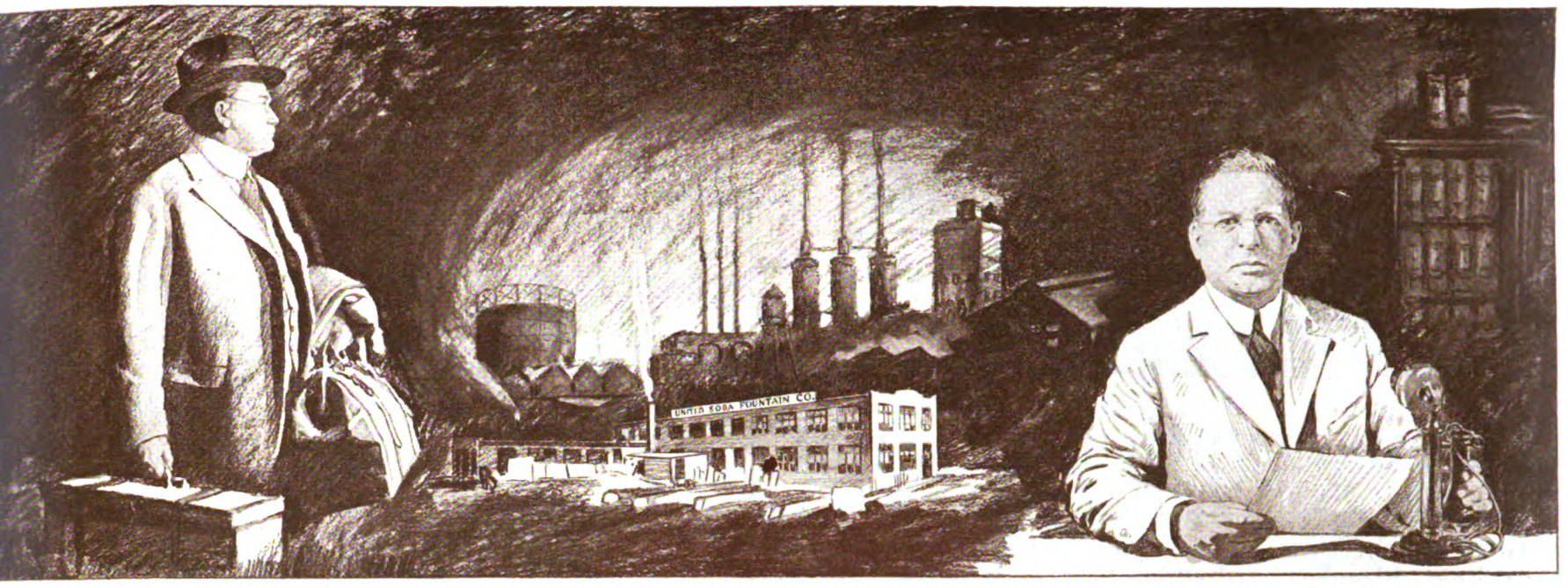


Schenectady Works Band giving noon concert for employees.



A Male Chorus, formed by one of the departments of a big manufacturing concern, which is in great demand.

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In three short years he put it across

But he had dreamed about it for fourteen years. Haven't YOU dreamed long enough?

THIS is a story for salesmen; for accountants; for technical men—for ny man who knows one department of usiness, and wonders how he is going) get to the top, either in the business 'here he now is, or in a business of his wn.

t has to do with a man named R. Lee mith, now Vice-President and Genral Manager of the United Soda 'ountain Company of Boston; one of ıe most successful concerns of its kind ı the country.

'or fourteen years he worked and reamed; then he added the training of ıe Alexander Hamilton Institute to is work.

And in three short years had made ıe dreams of fourteen years come true.

Thirty-eight; married; and a family

tarting as a salesman he became sales-ıanager of a company making soda ountains and their equipment. He was ıccessful in his department—sales. Most men who enrol with the Insti-ıte *are* already successful in the one de-artment of business where their ex-erience has been gained.) He was ıirty-eight. (Most men who enrol ith the Institute are between twenty-five and forty-five.) He was married (A majority of the men who enrol with the Institute are.)

And *this* was the driving power behind his decision: "I wished to afford my family advantages," he wrote, *"which otherwise they would not have had."*

"I had dreamed for years of my own business"

"For fourteen years I had been a salesman and salesmanager," he continued. "I had dreamed for years of my own business organization but my work gave me no understanding of business other than that which concerned selling. *I knew nothing of production, financing, or business promotion.*

"Your Course and Service gave me an understanding of these things."

He clipped a coupon from an advertisement like this. With the knowledge which the Institute brought to him, and with its encouragement and guidance, he organized the United Soda Fountain Company, erected a factory and started production. Straight thru the period of business depression the business has steadily grown; and now Mr. Smith plans to double its factory space and its output.

So three years work *with training* did what work alone had never been able to do.

A book that has made dreams come true

You who read Mr. Smith's story on this page are already familiar with the Alexander Hamilton Institute. You know how many thousand men there are who, like Mr. Smith—give it credit for having shortened their path to larger income and greater success.

The whole story of the Institute has been printed fully in a 118-page book—a book that should be in every thoughtful man's library. It is called

"Forging Ahead in Business"

For any man who is asking himself "Where am I going to be in business ten years from now?" there is a copy of this book without obligation. We would like to place it in the hands of *every* ambitious man. It helped Mr. Smith to give his family "advantages that otherwise they would not have had." Send for your copy now.

Alexander Hamilton Institute
596 Astor Place, New York

Send me "FORGING AHEAD IN BUSINESS" which I may keep without obligation.

Name.....
Print here
Business Address.....

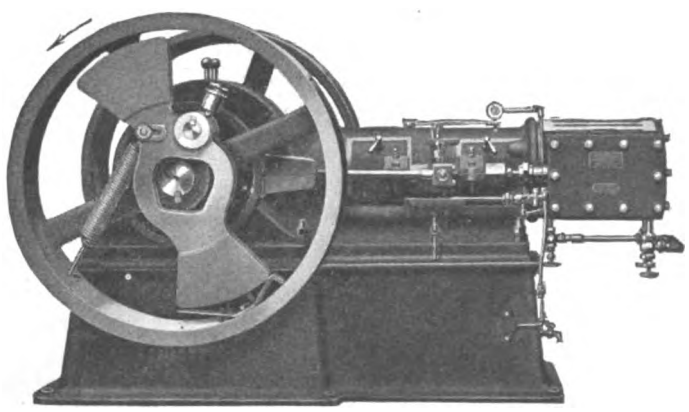
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Business Position.....

Canadian Address, C. P. R. Building, Toronto; Australian Address, 42 Hunter Street, Sydney

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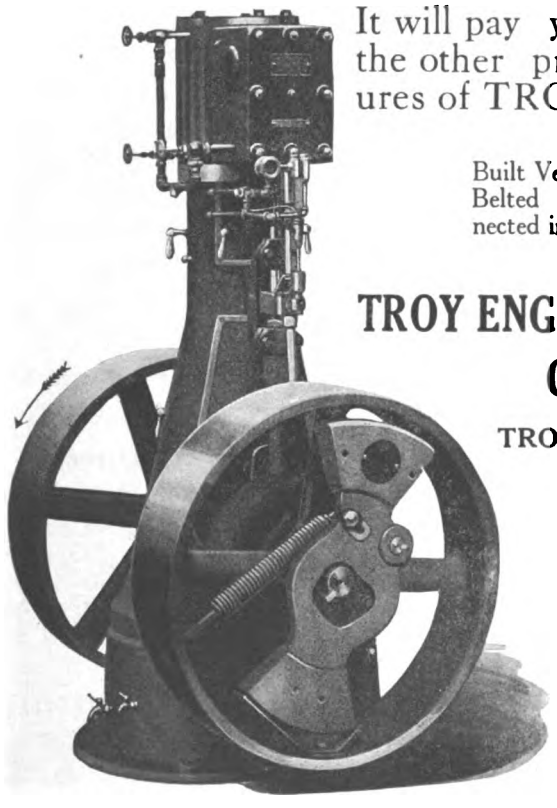
Conservation of Fuel

Important factors today in economic boiler operation are the small auxiliaries that propell the fans, stokers, blowers, and other boiler room equipment.

The fuel scarcity and high prices make fuel conservation absolutely imperative if the cost of power is to be kept at the minimum.

TROY Engines have always helped towards lower power costs by giving *greater brake horse power with the same steam consumption.*

The exclusive TROY System of Automatic Lubrication supplies an abundance of oil to all parts subject to friction, keeps bearings clean and reduces wear.



It will pay you to investigate the other profit making features of TROY Engines.

Built Vertical, Horizontal, Belted and Direct-Connected in 2 to 200 B.H.P.

TROY ENGINE & MACHINE COMPANY

TROY, PENNSYLVANIA

Send for descriptive literature

TROY ONLY STEAM ENGINES GOOD ENGINES ONLY ENGINES

Oblique Methods Bring Orders

(Continued from Page 19)

instance to prove the principle that added attractions in the way of entertainment or information make sales for the merchant. Izzy has given the stamp of his approval to the policy which John Wanamaker believed in when he installed a pipe organ in a department store. It's a principle which is not applied nearly so widely as it might be.

There are probably more examples of this sort of merchandising at Atlantic City than anywhere else in the country. Here, where people come by the millions for amusement, where the fakir and the side show vie with the wild waves and the bathing suits for people's attention, a number of manufacturers find it profitable to maintain, not retail stores, but merchandising exhibits, better suited to meet the holiday mood of the crowd than is the ordinary shop. Folk may drop in and rest in these display rooms, look at the products on view, see a movie or hear a lecture of interesting and informative character, and ask all the questions they wish, without feeling the slightest obligation to buy. Needless to say, they do buy, just because they aren't asked to, and their purchases run up into large figures, which, in addition to the inevitable publicity resulting from exposing thousands of good potential customers to their products, accounts for the interest of the Duponts, the American Tobacco Company, Heinz, Gainaday, and any number of electrical manufacturers and others in these displays.

It might seem that the minstrel shows and the boardwalk and the beach parade would offer pretty strenuous competition for the merchandising exhibit, but the fact is that people who come to Atlantic City to stay for even a few days, after a bit of frivoling feel the desire for something substantial again. They revert to type, so to speak, and the Heinz Pier, the Crosby and Elkins showing of the marvels produced nowadays in the electrical world, the "place where they make cigarettes" on Garden Pier, and the other exhibits of similar sort afford just the relief from the jazz that people seem to want, without bringing them back to their own serious business again.

There are a dozen or more such exhibits about the boardwalk, with every once in a while an "industrial exposition" here for a short period. Heinz started the thing thirty-five years ago, with one building, which has since grown into a pier. He had movies there fifteen years ago, when movies were a novelty, to say the least. Besides the pictures and lectures on how the fifty-seven varieties are made, and the demonstrations by ladies in white caps and aprons about how to use the various pickles and jams and sauces, he exhibits to the curious public something more than fifty-seven kinds of assorted objects picked up in all parts of the world, from marble busts of John Wesley to Buddhist household shrines and ferocious embroidered lions. And people flock there at the rate of 60,000 a day in August when the weather is good.

One pier down the beach from Heinz (to use Atlantic city parlance) the Lucky Strike people are making cigarettes and selling them to the crowd fresh toasted. Fifteen employees are kept busy here during the summer months, serving an average of 4,000 people daily. The Pennsylvania Rubber Company strikes a different note in regarding its display quarters as a "high class rest room" for the public. The Dupont Company has an exhibit covering nearly 5000 square feet of floor space, in which there are shown not only the explosives, chemicals, paints, varnishes, and other products as they are made by this company, but also goods of all sorts, from traveling bags to pictures frames, in which other manufacturers make use of Dupont materials.

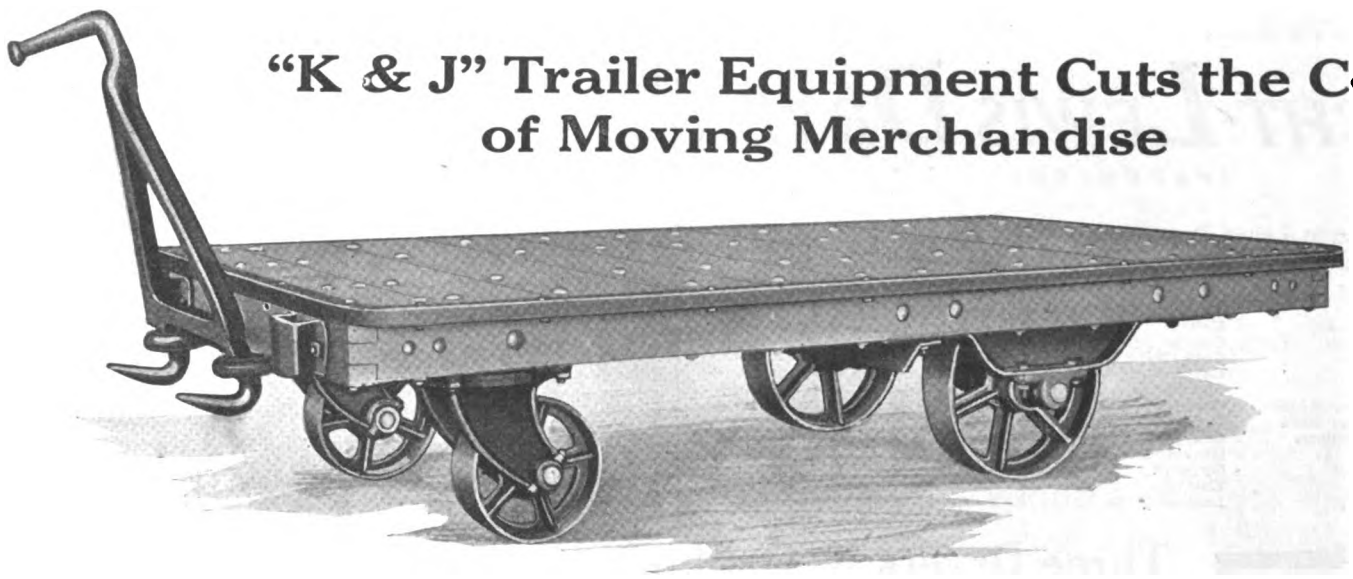
"A tremendous volume of business originates as a result of this unique method of sales promotion," said Mr. Daniel J. O'Connell, manager of the Dupont display. "Not only our own company, but also all the other manufacturers and all the dealers who handle these goods profit by it. We are constantly making new customers and turning their inquiries over to

(Continued on Page 30)

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"K & J" Trailer Equipment Cuts the Cost of Moving Merchandise



A good deal of "grief" resulted before motor truck users learned that converted passenger cars would not make successful motor trucks.

May trailer users never have to go through the same experience regarding hand trucks and trailers.

The "K&J" Organization produces both the hand truck and the trailer, each the best of its class, but in distinctly different classes.

Hyatt Roller Bearings are standard equipment on all "K&J" Standard Trailers.

Get Bulletin No. 510

TRADE MARK
THE SEAL OF SATISFACTION K&J REG.

One of several "K&J" Standard Trailers is shown here. This is a two ton type, platform length, 6 ft., width, 3 ft., height, 14 inches, wheels equipped with Hyatt Roller Bearings, approximate weight of trailer, 4000 lbs.

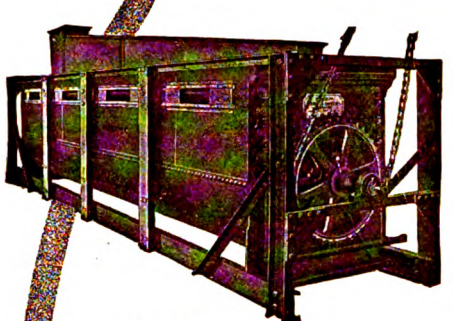
Many types of "K&J" Standard Trailers are offered or special designs will be furnished to meet special conditions.

The Kilbourne & Jacobs M'f'g Co., Columbus, Ohio, U. S. A.

New York Offices, 120 Broadway

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Solving Your Drying Problem



This Brecht-Lewis Dryer turns out greater volume—faster, better and cheaper.

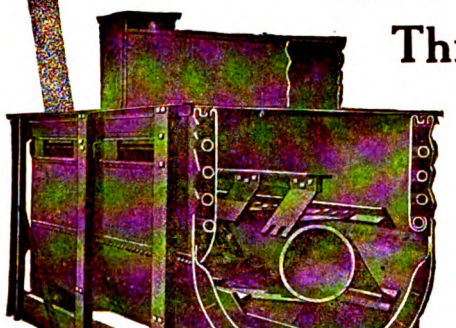
MANY drying problems vanish with the installation of a Brecht-Lewis Dryer. Greater volume, more perfectly dried product, and with lower steam consumption and H.P. used—that is the remarkable accomplishment of this new departure in dryers which can be operated either as a batch or continuous dryer at a saving over other systems.

BRECHT-LEWIS DRYER

(PATENTED)

The Brecht-Lewis Dryer opens a new era of economy in the drying of all materials of a loose, shredded or granular nature. Successfully handles:—

Apple Pomace	Coffee	Lime	Salt
Alfalfa Meal	Copra	Marl	Sand
Beet Pulp	Cork Chips	Metal Chips	Sawdust
Bagasse	Cotton Seed Meal	Nitrate of Ammonia	Silica
Bone	Fish Scrap	Nitrate of Potash	Soapstone
Carbonates of Lime, Potash or Soda	Garbage	Packing House Products	Sugar Refuse
Cereal Products	Grains	Peanut Hulls	Talc Rock
Chalk	Graphite	Peat	Tobacco Stems
Charcoal	Gravel	Phosphate	Whiting, and many other materials
Clays	Gypsum	Pumice Stone	
Coal	Kaolin	Rice	
	Leather Scrap		



Sectional view showing the improved method of heating and agitating—the secret of this dryer's efficiency.

Three Dryers In One!

This new design is really three Dryers in one; a combination of direct and indirect heat dryer allowing heat control from three sources—

1. From the steam drum,
2. From the jacketed bottom,
3. Hot air forced in from the side coils,

and is therefore adaptable to materials requiring either high or very low temperatures.

Hot air under pressure carries away the released moisture without recondensation.

Write for FACTS!

THE BRECHT COMPANY
1219 Cass Ave. St. Louis, Mo.

Branches:

New York, N. Y.
Chicago, Ill.
San Francisco, Cal.
Liverpool, Eng.
London, Eng.
Cape Town, S. A.
Buenos Aires, A. R.
Madrid, Spain
Shanghai, China
Mexico City, Mex.
Sidney, N. S. W.

The Brecht Company,
1219 Cass Ave., St. Louis, Mo.

Please tell me, without obligation on my part, how the Brecht-Lewis Dryer is adapted to my business, and how it will effect economies for me.

Quantity of material to be dried daily .....

Percentage of moisture in mixture .....

Percentage of moisture to be removed .....

Firm Name ..... Address .....

Attention of ..... Title .....

(*Continued from Page 28*)

retailers hundreds or thousands of miles away to make the sales."

Goods are sold at the exhibit only on request, but names and addresses of prospects are sent to local representatives all over the country.

This is also the arrangement of the Crosby and Elkins Company, which displays electrical devices in a handsome Garden Pier show room for a number of manufacturers. People drop in casually, to see what there is to see, and perhaps to ask a specific question, and they stay to gossip about things electrical, and sooner or later to give an order, or intimate that they may wish to do so soon. None of the leads they drop are lost on Mr. Benjamin S. Crosby, who sends a post-haste report to the "home town" dealer to follow-up. A big manufacturer who came in one day, for instance, sat and talked for two hours about electric furnaces, arranging, before he left, for further consultation on the subject at his own office in Pittsburgh. As they parted, Mr. Crosby asked him, "How much chance would a manufacturer's representatives have had to see you for this length of time at your desk?" And the executive smiled. "They've been trying to for years," he said.

Women come in and bring their knitting and stay all morning in this pleasant parlor overlooking the beach, and then when they go home they write back and order an ironer or a washer—one even sent all the way from Spokane for so small an item as an electric grill, apparently thinking that this was the only place in the world to buy one.

And Mr. Crosby has carried the exhibit idea a step further and proved its value as a merchandising method in other communities, where the unusual conditions of Atlantic City do not obtain. In eight or ten small Jersey towns surrounding the resort, he runs electrical departments for hardware dealers, furniture dealers, and others who do not themselves have the technical knowledge of the appliances. He sets up a merchandising exhibit in each shop, and instead of employing a trained salesman for it, lets the display talk for itself, and puts out a small force of expert electrical men to flivver from town to town and call on propects whose inquires have been noted by the dealers. These men demonstrate and close sales, and supply what instructions and servicing may be necessary for satisfactory operation of electric appliances.

The success of the experiment shows that the idea of the merchandising exhibit might well be utilized more generally by merchants. For this oblique sales method brings results. It puts people in a more generous frame of mind, by reason of the fact that you are giving them something free, and not hounding them to buy. The meeting of salesmen and customer in the usual store is likely to be an encounter of wits in which the prospect is instinctively on the defensive. But if you are merely dispensing useful information, or inviting the caller to be your guest and see a demonstration of an interesting industrial process, then the customer feels appreciation of your liberality and is likely to respond with a loosening of purse strings. Izzy, the newsboy, and John Wanamaker, the merchant, knew what they were about; the folk at Atlantic City have abundantly proved the soundness of their judgment.

Music as an Aid to Industrial Teamwork

(*Continued from Page 26*)

say nothing of its annual spring concert for the benefit of the Stetson Hospital.

Bands of the General Electric Company regularly led Liberty Loan parades in Schenectady, N. Y., Pittsfield, Mass., Erie, Pa., and Fort Wayne, Ind. In each of these places no great festival or procession occurs without the prominent participation of the G-E bands. The G-E chorus and glee club at the Erie works gave a minstrel performance in one of the theatres on one

(*Continued on Page 32*)

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ALLIGATOR



STEEL BELT LACING

WHY MEN CHANGE TO ALLIGATOR

Strength comes first in belt lacing. Then follow: durability, ease and speed of application, efficiency in service, range and economy.

Alligator is the Strongest Belt Lacing on Earth —and the most permanent. It is applied with a hammer in an average time of only three minutes.

Mechanically perfect because it binds the long burden bearing belt fibres in equal service. "Every Tooth A Vise." Rocker steel hinge pin endures in any service where the belt will run. The finished joint is flexible, separable and smooth on both sides.

There is a size for every thickness of belting and the price is so reasonable that **its use immediately becomes an economy.**

Sold through "Jobber Dealer" trade channels the world over.



The strongest belt lacing on earth.

"Never Lets Go"

If you are not using Alligator now, write us for sample and our interesting book "Short Cuts to Power Transmission." A trial of Alligator will be no less convincing than an analysis of its points.

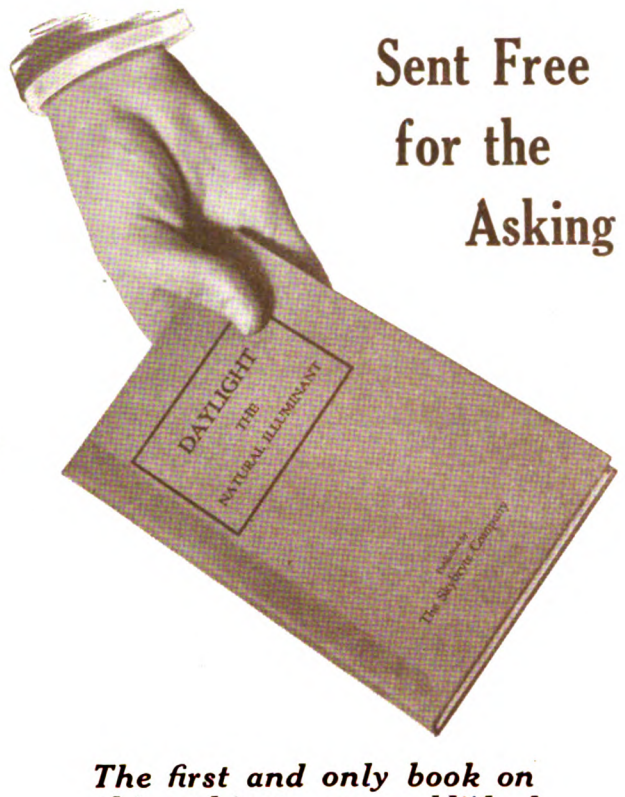
Flexible Steel Lacing Company

4639 Lexington St., Chicago, Ill.

In England at 135 Finsbury Pavement, London, E. C. 2.

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NOW READY!
"A Scientific Treatise on Natural Light"



Sent Free for the Asking

The first and only book on this subject ever published

THIS book explains what daylight is and points out its advantages and economies in plant operation.

It shows, and tells why adequate illumination decreases accidents and spoilage, increases production, stimulates the workman, makes him more cheerful, and safeguards his health.

The material in this book has been compiled after years of actual tests, experiments, and research work by the Skybryte organization; by exchange courtesies with the greatest laboratories and experiment stations in the world; and by foremost lighting experts of today.

This book contains a wealth of information heretofore unavailable.

It reveals the great waste due to neglect of natural lighting equipment.

It shows how greatly to increase the production of any plant.

It is of inestimable value to any industry.

This book, which has cost us thousands of dollars to prepare, will be sent free to those in authority in industrial plants. Just write your name and title on coupon below, attach to your letterhead and send to—

THE SKYBRYTE CO.
317 Bangor Bldg. Cleveland, Ohio

SKYBRYTE
FOR MAXIMUM DAYLIGHT

The Skybryte Co.: Please send me, free of charge, a copy of "A Scientific Treatise on Natural Light,"

Name _____

Title _____

Company _____

Address _____

(*Continued from Page 30*)

occasion, the affair becoming a city-wide musical event.

Weekly noon band concerts are a feature of life at the Schenectady plant of the General Electric Company. In one of the departments that employs a number of girls, the G-E- Choral Society is a well established institution. There is also a Switchboard Male Chorus and a General Engineering Laboratory Orchestra in this musically inclined plant.

The glee club of the Eastman Kodak Company, of Rochester, N. Y., not only appears at concerts in that city, but in many nearby towns as well. And the Winchester Repeating Arms Company of New Haven, has just opened its Winchester Girls' Clubhouse with an attractive concert, by plant talent, the beginning of a large season of affairs by the industrial songsters.

One motive lies back of practically every one of these shop musical organizations. It is the desire to drive away monotony and to keep it driven away.

In these days, the break in the working day which comes at noon is something far more than a mere listless, idle, purposeless hour or half hour. It is a time of real rational recreating of the spirits. Every day, almost, noonday concerts or snappy, compressed entertainments, are going forward in dozens of big industrial plants with a regularity and wideness of scope equalled only by the multitude of welfare entertainments given for the soldiers in the army camps during the war.

A visitor to one big plant described these affairs in these words:

"Shortly after the noon whistle blows, an orchestra or chorus or soloists, of local talent, suddenly makes an appearance in the midst of one of the great shops. A cover is lifted, and behold, there is a piano, incongruously kept amid the weird electric machines being assembled on all sides. A fifteen to twenty-five minute concert is held, the whistle blows, both the musicians and audience go back to work, and, like magic, the music of the volunteer entertainers is replaced by the great indescribable song of American industry.

"After one of these entertainments I asked the foreman how the piano came to be there, and he replied:

"'Each employee on this floor put in a penny a day for one month, and that paid for the piano.'"

In this particular plant, one of the General Electric Company's works, there are nearly 50 pianos in the shops, and a dozen phonographs.

Four bands, half a dozen glee clubs and choruses, and several orchestras and drum corps are in existence among the various factories of this company. The bands as a rule are managed by professional band leaders, and are maintained by the company. But many of the other musical organizations are the creation, and are under the sole management, of the employees.

Swift & Company has two musical organizations of high caliber. The first is its male chorus; the second is the noted Swift Military Band.

The male chorus made its first public appearance in May 1918. Since then it has given nearly forty concerts. It has sung many times in Chicago's churches and has raised large sums for church and charitable objects. The director is D. A. Clippinger, who is credited with having made this chorus what it is today.

As for the Swift Military Band, it is rated as one of the best known instrumental organizations in Chicago. There are about 75 well trained musicians, all of them employees by day in the offices and plant of the company.

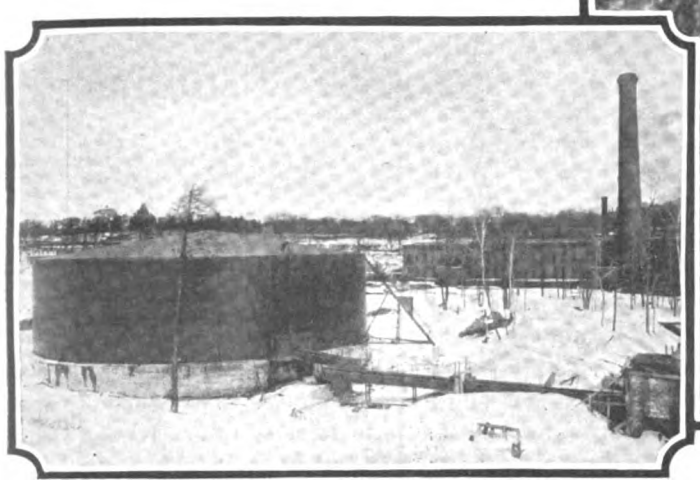
This band appears in public about forty times a year on an average. Concerts, parades, dances, open-air festivals and exercises are the principal events. Several out-of-town trips have also been made. Clarence Clark is the band leader.

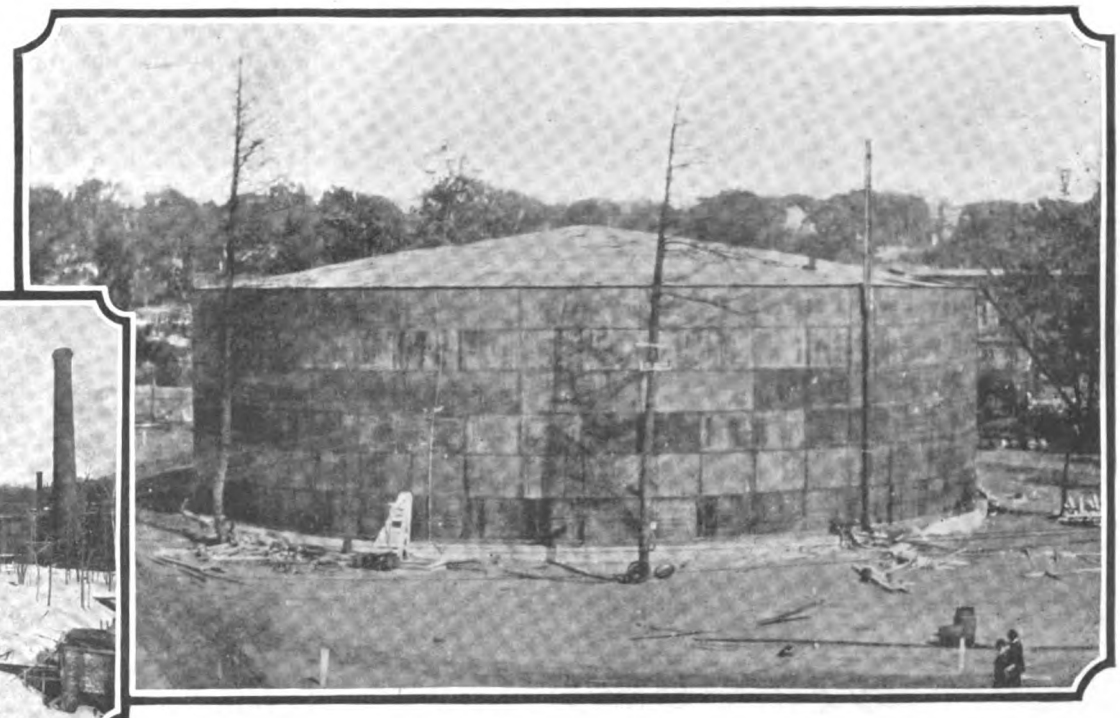
According to E. L. Ward, office manager of Swift & Company the band has been one of the factors in forming the splendid spirit that exists among Swift & Company employees.

A brass band, and a jazz band in the factories of the American Woolen Company at Lawrence, Mass., are con-

(*Continued on Page 34*)

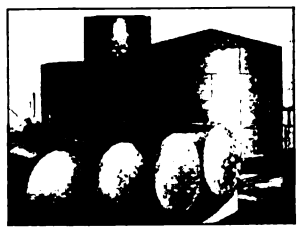
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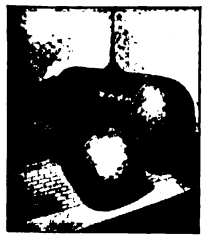




Recently, sixty-four vertical fire-tube 1,500 sq. feet boilers of the Manning type were converted from coal firing to oil firing, for a well-known New England manufacturer. The fuel storage system—two tanks of 55,000 barrels capacity—receives a large share of favorable comment.

Lancaster Tanks Help Make 64 Boilers Independent of Coal





THIS installation is typical of Lancaster workmanship. The fact that we are Tank Specialists is an important fact to you in these days of fuel worries. When you meet—for any reason—the problem of changing over to oil fuel, it is good for you to know that you can secure the maximum in Tank Engineering Service. It is good for you to know that Lancaster Iron Works has fabricated thousands of tanks for every storage purpose and that those Tanks are standing sturdy and strong because they were not only made right but designed right. They are designed right because our specialized experience gives us the ability to specify just what kind of tank is needed—how big and how heavy for any particular storage need.

Ask our Lancaster, Philadelphia or New York office to send a Lancaster Engineer to you. He will tell you how much fuel you should store, where best to store it, how many tanks are necessary. He will recommend the best tank for the purpose. That is part of what we mean by Lancaster Tank Engineering Service.

We have three very important books that are packed full of concentrated Tank information. They contain the boiled down results of twenty years' experience in fabricating Steel Tanks for every purpose. Any or all will be sent free upon request.

Book B-1	List prices and specifications on 303 sizes of Horizontal Storage from 100 to to 25,000 gallons capacity.
Book B-2	Storage Tanks, sizes from 1,000 to 74,000 barrels capacity.
Book B-3	List Prices and Specifications of 134 Standard Sizes of Pressure Tanks.

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LANCASTER IRON WORKS, INC.

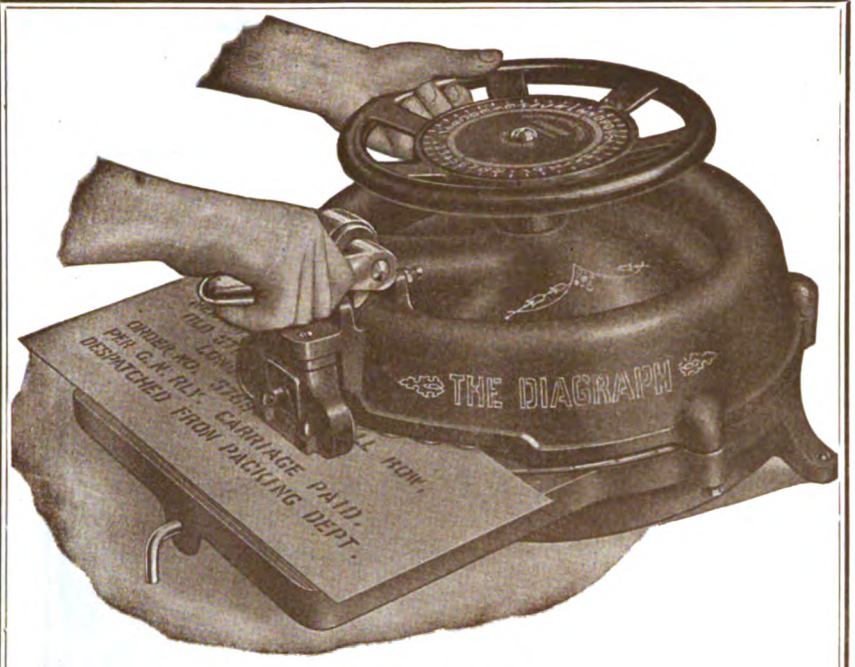
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New York

Wesley Building
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LANCASTER TANKS
STEEL PLATE CONSTRUCTION

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READ
"The Freight That Failed"
By Forrest Crissey

Every business man should read this illuminating article in the May 27th issue of The Saturday Evening Post. Mr. Crissey, in discussing the $100,000,000 annual freight claim losses, states that the use of stencils for addressing is a highly effective means of loss prevention. Read Mr. Crissey's article—then buy a Diagraph. Free trial in your own shipping room.

DIAGRAPH STENCIL MACHINE CORP.
1626 So. Kingshighway Blvd., St. Louis, Mo.
Branches in all principal cities—see phone book.

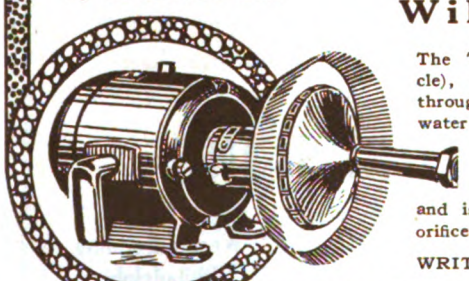
BREATHE LAUNDERED AIR

Clean wholesome air, containing the proper percentage of humidity, conditioned to a comfortable temperature, is absolutely essential for maintaining bodily vigor at its highest pitch.

The Bayley Turbo Air Washer

supplies pure air by passing atmospheric air through a fine water spray to remove impurities and through a conditioning chamber to regulate temperature and humidity. Uninterrupted service is assured by an atomizer that

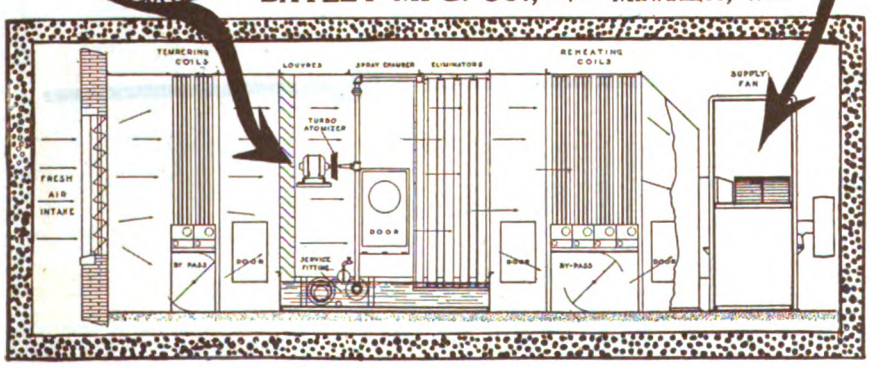
Will Not Clog



The Turbo-Atomizer (shown in the circle), distributes a fine spray evenly throughout the spray chamber, at low water pressure. Impurities washed out of the air will not clog it, as the smallest water passage is 5/8" in diameter. It fits any air washer and is an ideal unit for replacing fine orifice system

WRITE FOR FREE BULLETIN TODAY

BAYLEY MFG. CO., Dept.M Milwaukee, Wis.



(Continued from Page 32)

ducted by the employees but are backed by the company. They were organized in November 1919, when a number of talented players, who were formerly members of other bands, formed an industrial musical association. The jazz band is in big demand for dances and entertainments.

Piano music beguiles every noontime at the restaurant of this company, and also in the evenings at the service building for impromptu concerts and dancing.

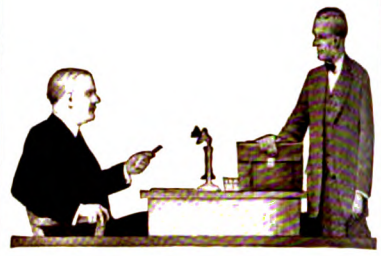
Employees of the Eastman Kodak Company hear music by a band, an orchestra and a glee club, the former consisting of both men and women and containing sixty members. The band gives concerts every noon during the summer and the orchestra plays for regular noontime dances, as well as several more formal affairs during the year. The glee club sings at intervals through the year inside the plant, as well as in public affairs outside the plant.

The latter organization dates back to 1911, when it was started as a male organization. It was thrown open to women in the following year.

Pianos and victrolas located in a number of departments of the John B. Stetson Company, of Philadelphia, are freely used. This plant goes outside for the biggest musical event under its supervision in the season, inviting the Philadelphia Orchestra to give one concert annually, which becomes the most popular affair of the year. The Stetson Chorus, containing one hundred voices, is twelve years old. There is also an orchestra and banjo-mandolin club in the plant.

Musical organizations have been in existence for four years at the plant of the National Cash Register Company at Dayton, O., and include two orchestras and a chorus.

The encouragement given these musical tendencies among industrial workers has been an accompaniment of general pleasant relations between employees and employers in plants that are noted for the smoothness with which their affairs progress from day to day.



"IT'S YOUR ORDER, Because Your Company Has a PHOTOSTAT."

"This is a job where delivery is paramount. And, in every case, I have made it a point to find out what kind of equipment the bidder had in order to make good his promise.

"Your Company has a piece of equipment on which I have learned to rely. I know what the PHOTOSTAT is and what it can do. I know you will not have to lose any time tracing. You can make PHOTOSTAT copies and get started on your shop work right away. In other words you'll be days ahead and I also know that there can't be any mistakes in PHOTOSTAT copies.

"Yes, sir, you tell your chief he can thank the PHOTOSTAT for this order. I know you'll make delivery with that machine to help you."

PHOTOSTAT prints cost cents. Compare this with what it costs for a draftsman to make a tracing, a stenographer to copy a page, or an artist to reproduce a layout.

The experiences of many users, written in letter form, are contained in our booklet, "A Good Word for the PHOTOSTAT." Write for your copy today.

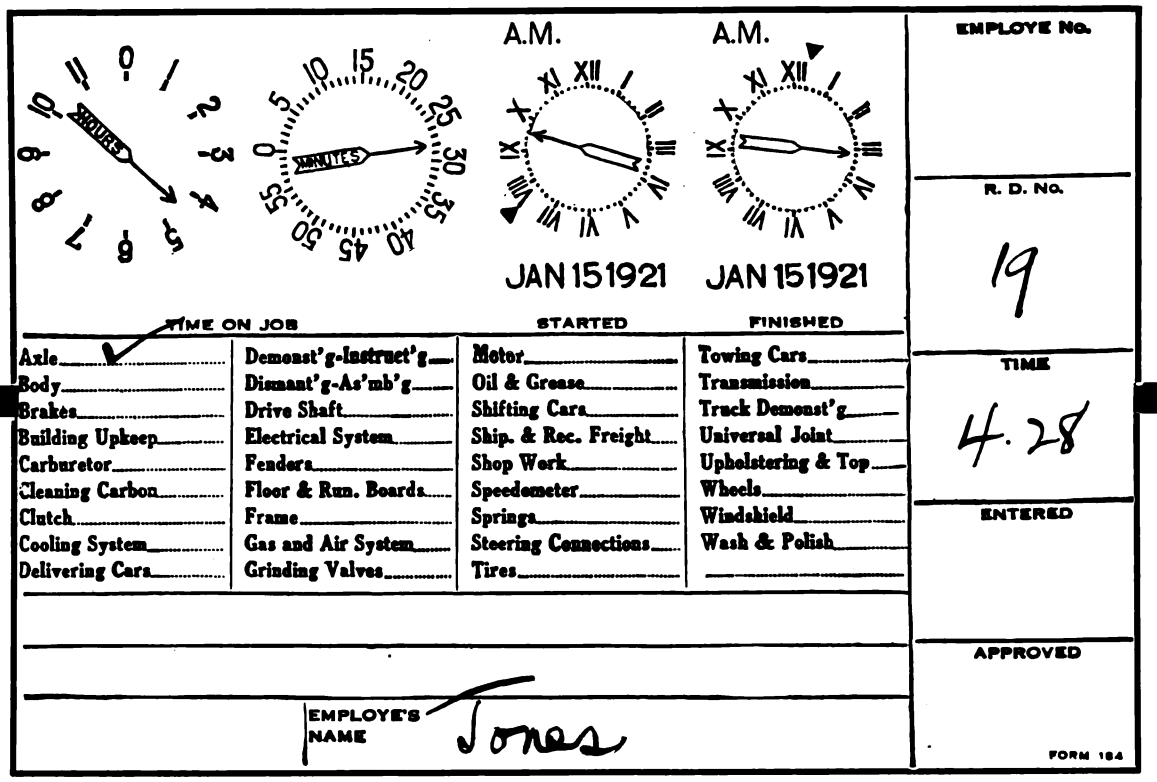
PHOTOSTAT CORPORATION
295 STATE ST., ROCHESTER, N. Y.

88 Broad St., Boston
123 W. Madison St., Chicago
209 Leader Bldg., Cleveland
7 Dey St., New York City
510 No. American Bldg., Philadelphia
317 Third Ave., Pittsburgh
429 Monadnock Bldg., San Francisco
601 McLachlen Bldg., Washington.

Executive Office: Providence, R. I.

PHOTOSTAT
Trade Mark

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The Difference between Practically and Actually

"It took me practically four hours on that job," and that is the way Jones would have reported his time for putting the new axle into the doctor's car.

As a matter of fact, that record on the Calculagraph showed that it actually took him 4 hours and 28 minutes and when the doctor complained that it seemed a long time for such a job, the foreman brought out the time ticket which showed the following:

Jones began the job on the axle Jan. 15, 1921 at 7:48 a. m. He finished the job on Jan. 15, 1921, at 12:16 a. m. The Calculagraph automatically calculated and printed the elapsed time record on the face of the card showing that it took Jones 4 hours and 28 minutes. The doctor was charged accordingly.

Jones is a good, steady worker. The Calculagraph is a mechanical elapsed time recorder the record of which cannot be falsified. In these two the service station had an argument that convinced the doctor of the fairness of the charge. He was satisfied that this Service Station was making an effort to give their customers a "square deal."

But the Calculagraph is not designed for Service Station work only. It is in daily use in thousands of Garages, Repair Shops, Machine Shops, Factories, Billiard Parlors, Telephone Long Distance Lines, Industrial Plans, Power Houses, in fact, wherever an accurate Elapsed Time Record is of value.



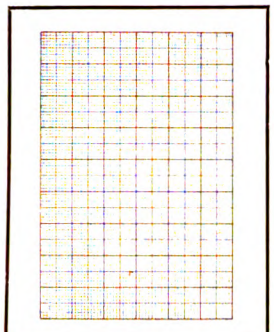
Learn more about this durable Elapsed Time Recorder, by sending today for a complimentary copy of that valuable booklet:-
"Elapsed Time Records."

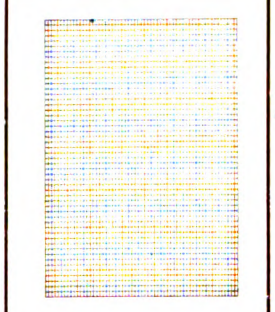
THE CALCULAGRAPH
THE ELAPSED TIME RECORDER

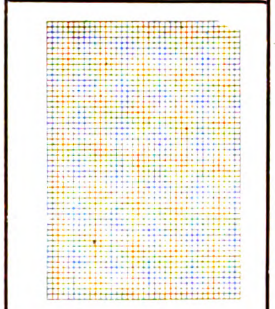
34 Church Street **New York City**

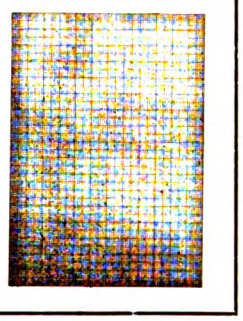
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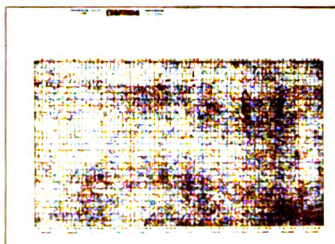
GRAPHICS H

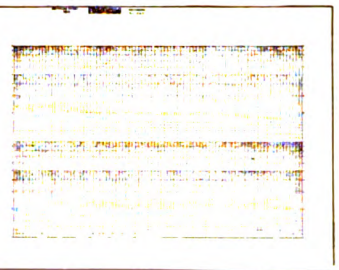


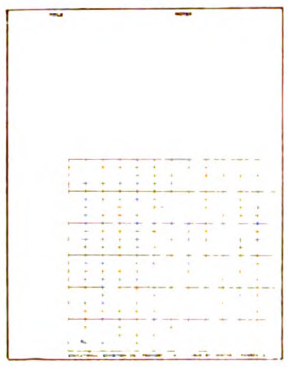












EDEXCO CHARTING PAPERS

These are the sort of charting papers you want because;

1. They are printed on letter size paper, so that they are easy to file in letter files or bind up with typewritten reports.

2. Wide margins are left around the engravings for insertion of scales, heading and notes. They are printed on white (on one side only) in a color of ink which reproduces readily.

3. They are printed on paper which is strong enough to stand hard usage but which is unwatermarked and transparent so blue prints can be made.

4. Most EDEXCO sheets are specially divided for plotting business data by days, weeks, months and years and contain the right number of spaces for this purpose. EDEXCO curve cards also embody all these features.

5. The arithilog papers, are very necessary for comparing rates of large and small items, such as waste with production and advertising with sales.

A few of our forms are illustrated in the border. For more information ask for Catalogue H or better still send for—

OUTFIT A

Combination Laboratory Outfits on Charting $3.

This outfit contains charting paper and instruction booklets for a study of how to graphically record facts on charting paper. All styles are shown and besides annotated samples there are blank working sheets ready to try on your own business figures.

WORKING SHEETS

16 kinds 8½ x 11 inch charting paper: 8 blank and 8 with brief description of the uses on each. Ten sheets 8½ x 11 inch Arithilog Paper: one No. 179, 3-No. 180, 2-No. 181 and one each, No. 181½, No. 182, No. 183 and No. 184.

BOOKLETS OF INSTRUCTION

Pamphlet No. 805, "Standards for Graphic Presentation." Pamphlet No. 806, "Graphic Charts for the Business Man", —Gilman.
Series of 4 reprint articles "The Ratio Chart and its Applications."—P. A. Bivins.

OTHER EDEXCO SUPPLIES

Graphic Headquarters also carries in stock for your convenience many other devices you can't get readily elsewhere. For instance;—

Gummed Paper in colors. In sheet form or cut as tapes or symbols.

Colored Crayons, Oil Colors and Waterproof Inks.

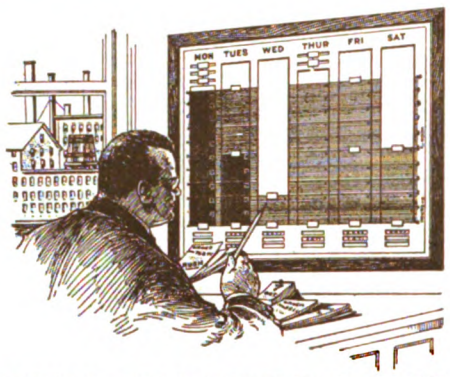
Swinging Leaf Fixtures with cork filled leaves.

Decimally-divided Stop Watches.

EDEXCO Cork Mount for maps, charts and bulletin boards. The best backing for pin charts in constant use.

Books on Graphics.

Catalogue H will tell you more.



EDEXCO COMPOSITE BAR CHART

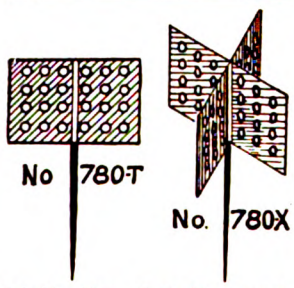
For showing condition or quantity of stock on hand or for assigning work to machines or departments.



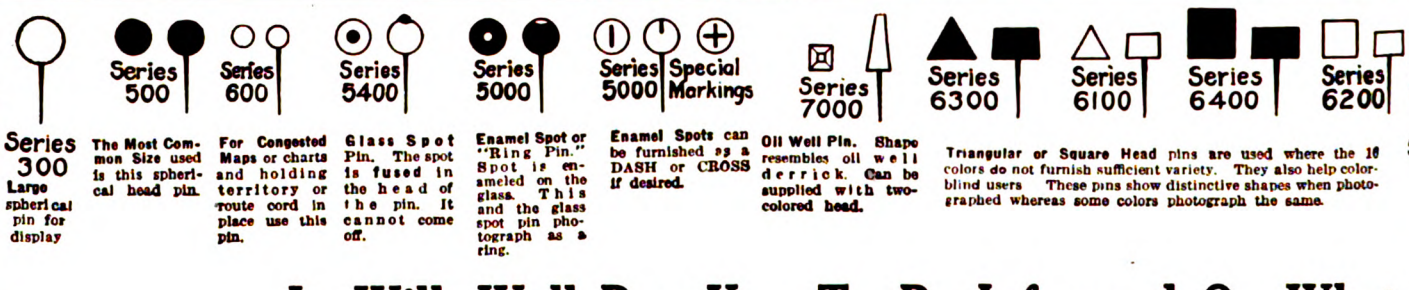
EDEXCO ME

EDEXCO MECHANICAL BAR CHARTS, factory control boards, showing amounts in v also been extensively used with great success pulation, flexibility of use and neat appearance

EDEXCO PINCORD CHARTS though newe Graphs" goes into detail.



Pole Line Pins. Used with map cord to show power circuits on city plans or piping lines in a plant. Metal, two styles.



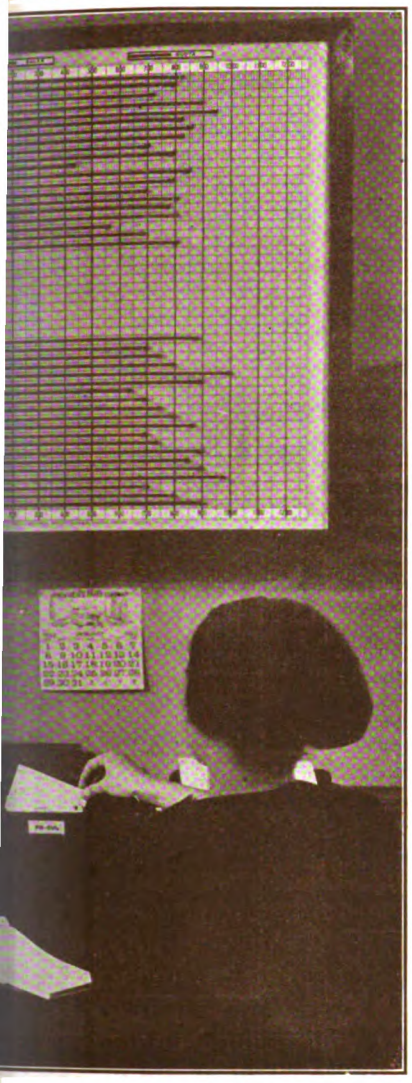
It Will Well Pay You To Be Informed On What Gra

EDUCATIONAL EX

427 CUSTOM HOUSE STREET

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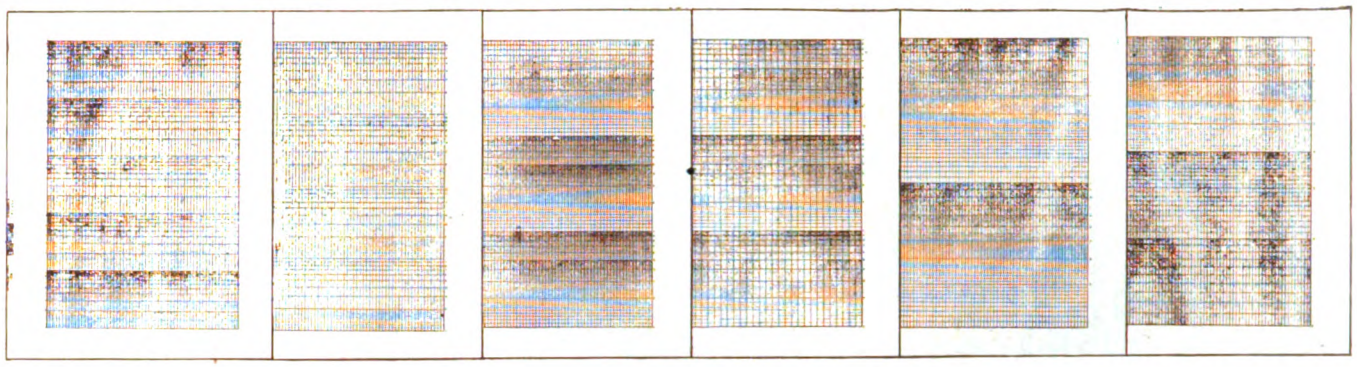
ADQUARTERS



L GRAPHS

d exclusively by us, are especially useful as keeping perpetual inventory. They have smen. Their brilliant colors, easy mani- le part of the conference or director's room.

e. Our illustrated pamphlet "Mechanical



EDEXCO OUTLINE MAPS

The sort of maps you want and can't get elsewhere.

Plain U. S. Outline Maps showing every state with no lettering, in several sizes.

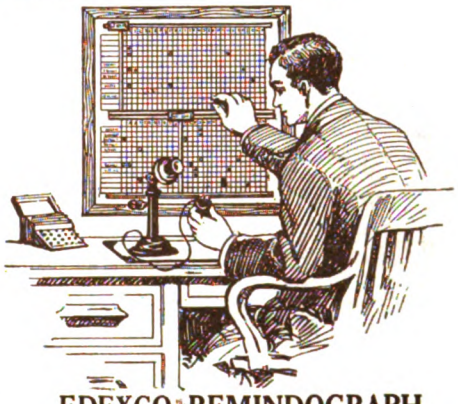
Individual State Maps showing county names and boundaries with plenty of room for coloring in or insertion of data in the handy 8½ x 11 inch size.

Large U. S. Maps showing all counties for sales territory work. Two sizes, one as large as 4 x 6 feet.

Maps of U. S. showing cities of given population; 25, 50 and 100 thousand respectively, corrected to latest census.

Also plain black and white maps showing railroads, cities and other details.

Catalogue H will give you details.



EDEXCO REMINDOGRAPH

An automatic mechanically operated follow-up device for routing orders through the factory or checking up on delivery of raw materials.

EDEXCO MAP PINS

These EDEXCO Markers for production charts and maps are available in 16 standard true colors and over 30 varieties among which the following are particularly useful.

1. Solid Color glass heads. The color is fused in and extends all the way through the homogeneous head.

2. Sharp steel needle points permit repeated use in production charts or sales maps. When EDEXCO Cork Mount is used 100 or more insertions in the same spot are possible.

3. Rough Surface Colored Pins you can write on with lnk or pencil. Erasures are easily made and pins can be used repeatedly.

4. Numbered Glass Head Pins with either black or white number against a brilliant color background.

5. Square and Triangular Pins which show up well in photostats or photographs where colors would otherwise disappear.

30 styles are shown in the lower border. For more information write for Catalogue H or better still send for—

OUTFIT B

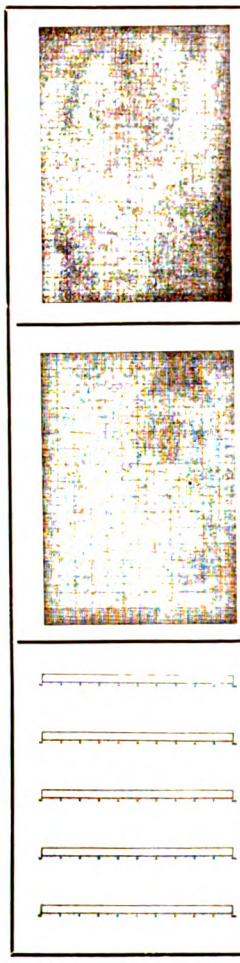
MAP MARKING OUTFIT—$2.00

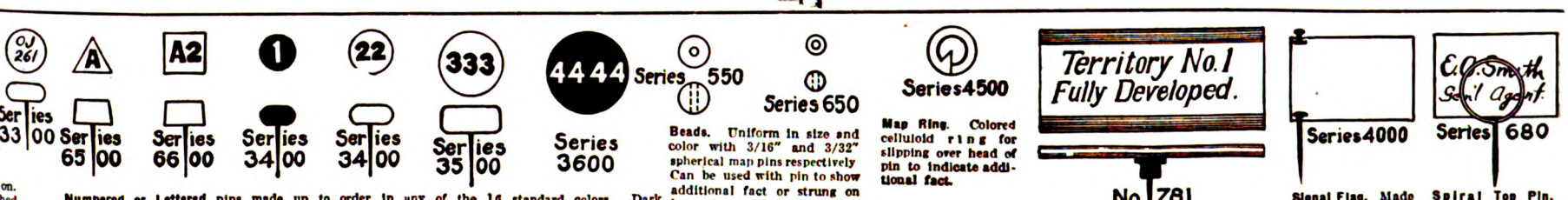
1 8½ x 11 inch Map of U. S. on EDEXCO Map Mount, with standard washable finish.

1 box of sample Map Markers, containing 100 map pins (some loose for experimentation).

1 box of 95 loose triangular, square and glass spot pins for special markers.

1 EDEXCO Primer of Graphics, telling how to mark maps.





Numbered or Lettered pins made up to order in any of the 16 standard colors. Dark colors with white letters photographed as black circles enclosing the figures. Use size of pin admitting maximum number of figures required. These numbered pins used in sets 1-31 to indicate days of the month. Also alphabet sets A-Z.

Beads. Uniform in size and color with 3/16" and 3/32" spherical map pins respectively Can be used with pin to show additional fact or strung on long pins to show accumulation or quantity at one spot.

Map Ring. Colored celluloid ring for slipping over head of pin to indicate additional fact.

Large Label Pin for display work Any copy printed on this to order Can be furnished in any color

Signal Flag. Made of celluloid. One side glossy, one can be written on. Useful for indicating special attention or where a flag is preferred to a pin.

Spiral Top Pin. Furnished with card in any of the 16 standard colors. Useful where much data must be written out.

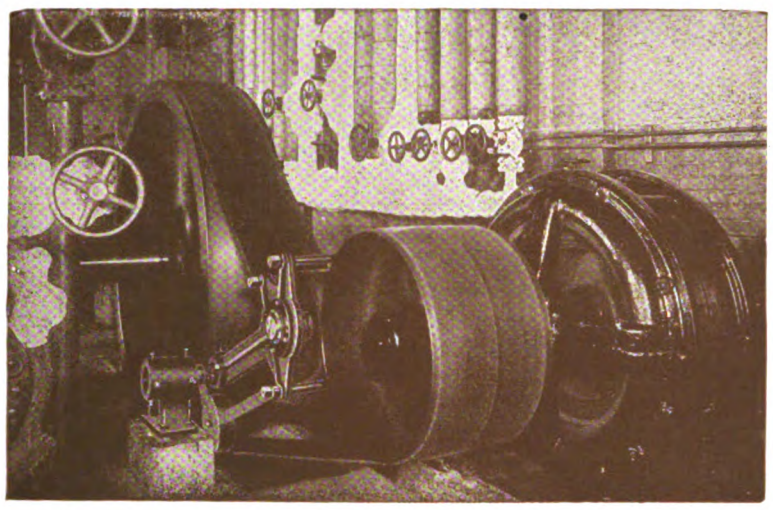
quarters Has Available, Write Now To

BITION COMPANY

PROVIDENCE, RHODE ISLAND, U. S. A.

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The Korap* Lenix Drive



200 H.P. Motor, 2-Bearing Type, Driving Ammonia Compressor.

Initial tension in bearings is absolutely necessary with ordinary open belt drives; it is practically non-existent with the KORAP-LENIX Drive.

With the KORAP-LENIX, two-bearing motors of much larger horsepower may be successfully operated where three-bearing motors with open belt drives would be essential.

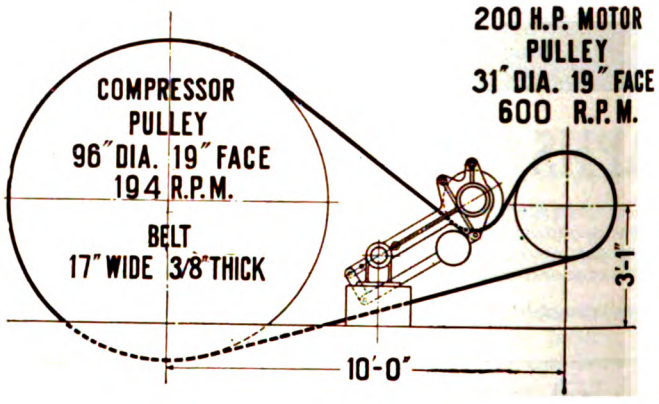
The saving in first cost of motors is obvious.

The practical absence of *initial* tension with the KORAP-LENIX Drive saves in bearing friction, lubrication and bearing renewals.

Belt slippage is eliminated—SAVING POWER.

The short pulley centers, not only possible but preferable with the KORAP-LENIX, save floor space.

Booklet
"SAVING SLIPPAGE AND SPACE"
contains interesting data on belt drives. Ask for a copy.



F. L. SMIDTH & CO.

Engineers

50 Church Street **New York, N. Y.**

*Improved LENIX Drive.

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The Modern Telegraph—Its Methods and Operations

(Continued from Page 23)

o the moment of delivery at s destination.

In his New York office, Mr. Gregson of Gregson and Todd, Attorneys, wishes to reach a lient in Kansas City. This lient possesses some facts hat Mr. Gregson must know nd it is imperative that he ave them the same day. The ands of the clock in Mr. Gregon's office point to noon. Writing is out of the question; t is time to act and act quicky. He calls his private secreary and dictates a telegram. Before transcribing her stenographic notes of the message, he rings a call box. By the ime the message is written, he messenger has arrived and he telegram is on its way.

An hour later Mr. Gregson returns from luncheon and finds on his desk an answer from his client in Kansas City.

And this is how it is done:

The moment the call box is rung the machinery of the telegraph company is set in motion. The box is circuited to the nearest telegraph office, several blocks away, and the call is registered on one of the eight or ten circuits which constitute the call box board. Each circuit has a bell of a different pitch, and on this bell a certain combination of numbers are struck. At the same time this particular number is registered on a strip of paper. In a card index underneath the board are kept the numbers, arranged in sequence, and the name and address of the firm corresponding to the number. But so expert has the call clerk become that he not only knows, by the pitch of the receiving bell, on what circuit the call occurred but also, by the number of strokes, the calling firm.

The messenger boy is dispatched and returns a few minutes later with the message, which he gives to the receiving clerk. The clerk time-stamps it, checks the number of words, and the message is then placed in a tube carrier and shot through an underground pneumatic tube to the main office. The Telegraph Company operates the greatest tube system in the world, there being hundred of miles of such tubes in New York and the other large cities throughout the country.

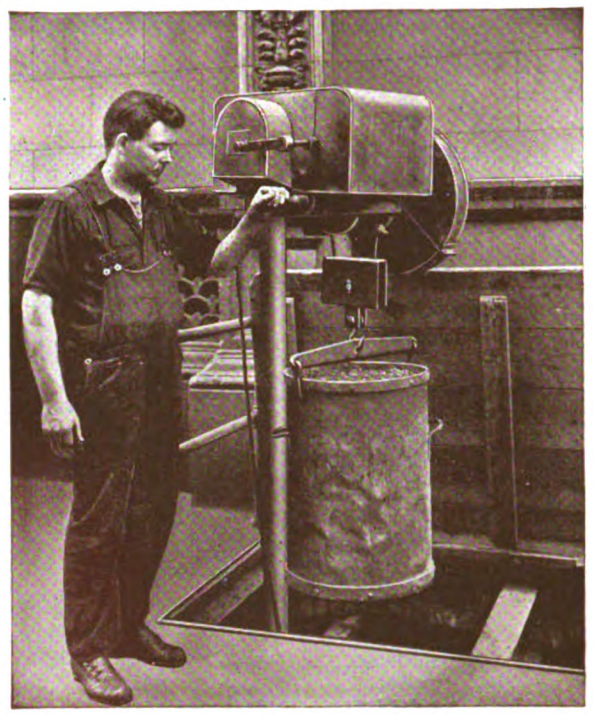
The message is removed from the tube in the New York main office and placed on a conveying belt that carries it to a distributing center. Here it is at once placed on another moving belt that quickly carries it into one of the operating rooms, where it is automatically deposited in a chute by the side of a supervisor, who places it in a container by one of the sending operators.

This operator, working at the sending end of a Multiplex, is seated at a perforating machine, an instrument with a regular typewriter keyboard, but whose keys produce certain combinations of holes on a strip of moving paper. As the message is typed on the tape, it passes instantly into an automatic transmitter. The number and position of the perforations produce a series of electrical impulses on the wire and operate directly the multiplex printer at the receiving end in Kansas City. The actual transmission is instantaneous, occupying but the minutest fraction of a second.

The receiving of the message at Kansas City is entirely mechanical. A detailed description of just how the electrical impulses operate the Multiplex Printer would require a lengthy explanation of a highly technical character, which is not possible here. It is sufficient to say that a certain combination of impulses operates a corresponding letter upon the Multiplex Printer, and the message is thus produced in typewritten form, the spacing and proper arrangement of date line, address, etc., also being done mechanically.

At the destination the same efficiency of handling is shown. The moment the message has been received, it is time-stamped, placed on a conveying belt that passes in front of the operator, and is carried to a distributing center. If necessary it is routed by tube to a branch office and delivered by messenger.

A message going to a large town or city is delivered within 20 minutes, and within an hour in remote places.



227 Cans of Ashes Handled Electrically in One Kilowatt Hour

THIS test proves conclusively the economy of operation of the G&G Model E Electric Hoist.

At the Hotel Navarre, 7th Ave. and 37th St., New York City, estimated cost of current is slightly under 5 cents per k.w.h., and the official figures of the test (made with 6 cans—height of lift 9 feet) are as follows:

Raising Cans

Can No.	Volts	Amps.	Watts	Secs.
1	107	7.0	749	6.5
2	107	7.4	791	6.5
3	107	7.0	749	6.25
4	108	7.0	756	7.0
5	108	7.0	756	6.5
6	107.5	6.8	731	6.5

Average Watts, 755. Average Seconds, 6.6

Lowering Cans

Can No.	Volts	Amps.	Watts	Secs.
1	109	15.0	1635	7.0
2	105	15.0	1575	7.0
3	105	15.0	1575	8.0
4	105	14.5	1522	6.5
5	105	14.5	1522	6.5
6	105	14.5	1522	6.75

Average Watts, 1558. Average Seconds, 6.96

Average cost of operation of this G&G Model E Hoist (current consumption only) is, therefore, 1 cent for raising and lowering every 45 cans.

If you will tell us the kind of loads you are handling, the distance of lift, and something about the working conditions, our Engineering Department will be glad to recommend the proper G & G Hoist to meet your requirements and will quote you the cost of same. It places you under no obligation to ask for this information.

GILLIS & GEOGHEGAN

556 West Broadway **New York City**

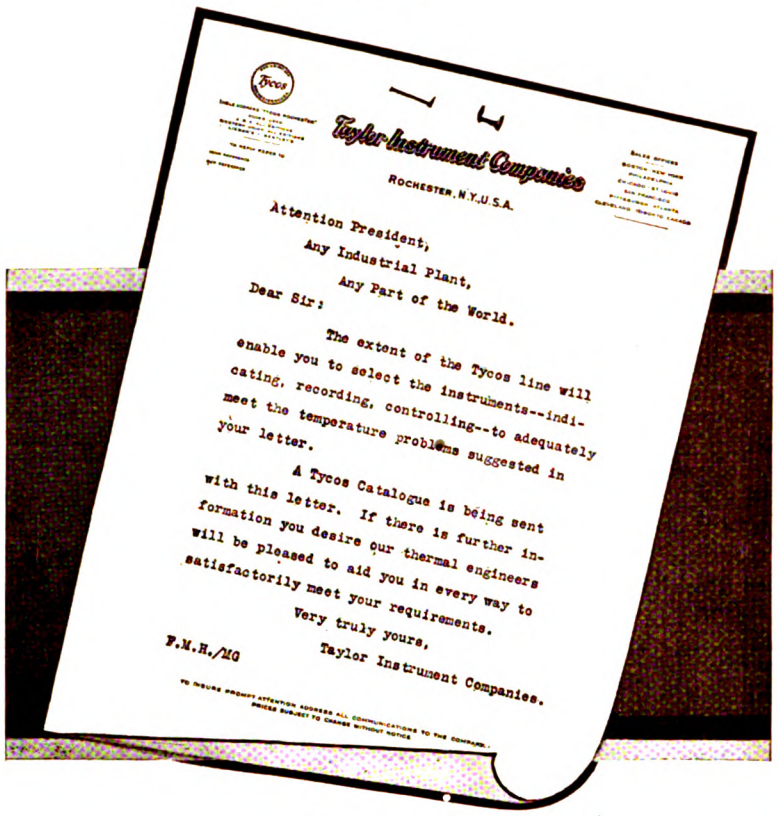
The G&G ELECTRIC REG. U.S. PAT. OFF Telescopic Hoist

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Temperature Instruments

Tycos

INDICATING CONTROLLING RECORDING



In our entire line we list over 8,000 types and styles of thermometers and temperature indicating, controlling and recording instruments—from the delicate fever thermometer to take body temperature, to the pyrometer taking temperature by the thousands of degrees. The industrial applications are myriad. One of our catalogues lists instruments for steam and power plants, heating, ventilating, marine engineering.

—Another for industries depending on vacuum processes.

—Another for ice manufacture, refrigeration, cold storage and industries where the primary requirement is low temperature.

—Another catalogues instruments used in brewing, bottling, malting, distilling.

—Another covers canning, packing and allied industrial requirements.

—Another is devoted solely to gas works, by-product coke ovens and gas power plants.

—Another, industries in which the principal operation requires the use of long stem, high temperature thermometers.

—Another is for the baker, confectioner and allied industries.

—Another covers a complete line of regulators for controlling temperature in enclosed spaces.

—Others are devoted to milk industries.

—And still others to thermo-electric pyrometry.

Taylor Instrument Companies
Rochester, N.Y. U.S.A.

Theres a *Tycos* and *Taylor* temperature instrument for every purpose

323

For the instant discovery of any breaks along its lines, the Western Union maintains an elaborate testing and regulating department. The test boards, located in the main office, are under the supervision of a wire chief and his assistants. By means of various testing instruments they quickly locate any break or fault and immediately substitute another wire over the most direct route available.

For example, a direct New York—San Francisco circuit may become crossed with another wire or develop other faults anywhere along the line. The trouble is usually discovered and another wire substituted within one or two minutes, after which the assistant wire chief finds where the trouble is by means of a so-called bridge testing set, which locates it so closely that the lineman may be told precisely where to go even to the number of the telegraph pole where the break occurred.

Several other features of the Telegraph Company's service are well worthy of comment. The telegraphic money transfer service for example offers the quickest means of sending money from one place to another. During the period of the war it was of immense benefit to relatives and friends of the soldiers in France. It is used in normal times for every purpose for which money can be sent and is constantly growing. During the year 1921 over $10,000,000 was transferred in this way.

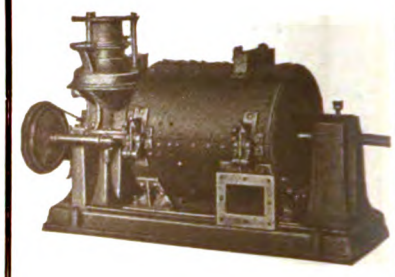
A second feature that has grown to important proportions is the maintenance throughout the country of self-winding clocks, regulated by signals from the Naval Observatory at Arlington, Va. At the present time over 100,000 of these clocks are in operation.

In closing that part of this article that deals with the land lines, a few words should be said about the part that the telegraph is playing in modern industry. The fact that the volume of traffic handled over the telegraph lines has more than doubled in the last decade, is due to several causes.

The business man of today is quick to realize the attention-compelling properties of the telegram, together with the fact that it invariably reaches

(Continued on Page 43)

Pulverized Coal



The Aero Unit System

of Pulverized Coal again demonstrates, as in other work of human endeavor, how an original idea at first worked out by complicated and costly methods is finally simplified and perfected until it becomes a part of our every day existence.

The Unit System reduces the equipment and therefore the cost to a minimum by placing the Aero Pulverizer at the furnace where the coal is fed to the machine undried and is exhausted therefrom directly into the furnace. There are no dryers, no storage or long lines of transportation for the powdered coal, thus eliminating the hazard of fire or explosion.

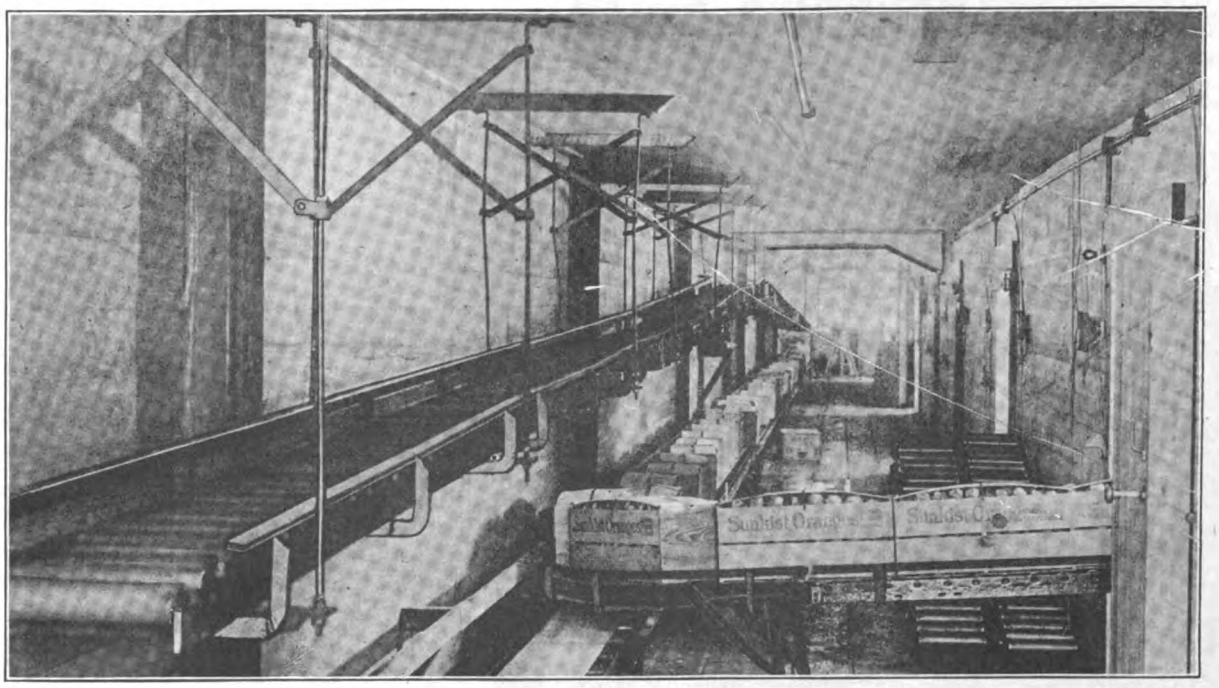
Each Aero Pulverizer is designed as a complete powdered fuel unit for one furnace. They are built in standard sizes ranging from 600 lbs. to 5000 lbs. of coal per hour.

Bulletin Sent on Request

AERO PULVERIZER COMPANY

165 Broadway New York

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The Mathews Gravity Conveyer saves floor space in two-way conveying

Gravity displaces non-producers

Labor engaged in trucking, carrying, or any other form of conveying is non-productive. It yields no marketable returns for its wages.

A Mathews Gravity Conveyer will materially reduce non-production expense. It will displace practically your entire conveying force and keep materials always on the move. It will do your carrying more quickly and dependably than man-power and reduce breakage costs. Production will not be slowed up by the non-arrival of raw materials or congestion of the finished products when you depend on the

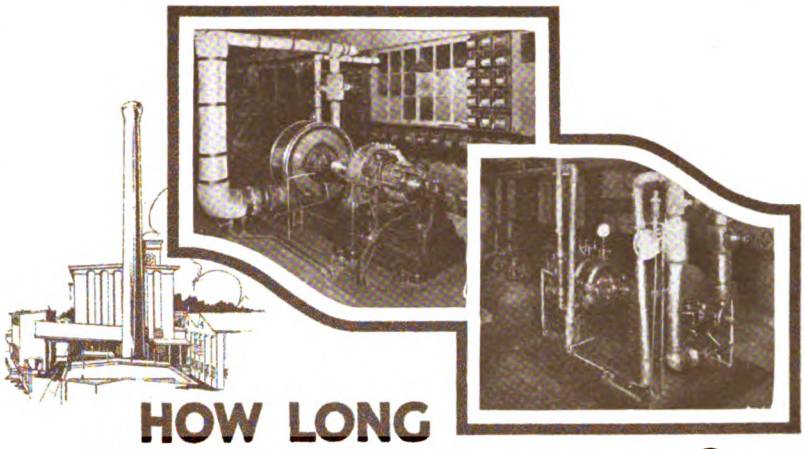
MATHEWS
SPEED ECONOMY
GRAVITY ROLLER CONVEYER

The Mathews system can be used for outside or inside conveying, from building to building, over roofs and through walls. The portable or permanent sections of steel ball bearing rollers can be supplemented by a number of special devices that make this system the most adaptable on the market.

Upkeep costs are negligible. The rollers are fitted with detachable ball bearings and full length axles. The sturdy construction will give enduring service under the most strenuous conditions of usage. Find what the Mathews Gravity Conveyer can save you. Drop us a line and we will send an engineer or illustrated literature, or both.

MATHEWS GRAVITY CARRIER COMPANY
157 Tenth Street, Ellwood City, Pa.
***Branch Factories*—Toronto, Canada—London, England**

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HOW LONG SHOULD A TURBINE LAST?

WHILE the life of any piece of mechanical equipment depends to a large extent on the care and attention it receives, its potential life depends upon materials and design. The illustration at the top shows a Terry Lighting Set installed in 1911 at the plant of Joseph Benn Sons, Inc. There were no shutdowns or repairs until it was overhauled in 1921 when the glands, bearings and wheel were replaced.

The Terry Boiler Feed Unit illustrated at the right was installed in 1912, a new wheel was all that was necessary when it was overhauled in 1921. By replacing these worn parts they have practically restored the turbines to their original condition. Dividing the cost of these repairs by the number of years in operation shows an exceptionally low upkeep cost per year, thus it is possible to prolong the life of the Terry Turbine indefinitely by replacing the few wearing parts. This is an important item to bear in mind when considering the first cost of your Steam Turbine.

Bulletin Z-25 describes in detail the wearing parts and shows their accessible arrangement in the Turbine. Write for it and you can easily see you are making a permanent investment when you buy.

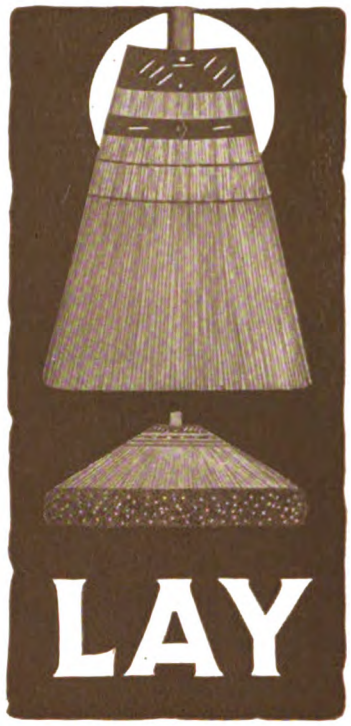
T-793

THE TERRY TURBINE

Offices in Principal Cities in U.S.A. also in Important Industrial Foreign Countries

The Terry Steam Turbine Co. Terry Sq. Hartford, Conn. U.S.A.

Save 50% in Your Sweeping Expense



Metal Case Brooms
Bench Brushes Casting Brushes
Street Brooms Hickory Fibre

by using LAY STAPLED METAL CASE BROOMS. Briefly, because they last longer, sweep cleaner and cost less per unit of service.

FORTY-FOUR YEARS

of broom making experience have been incorporated in our Patented Stapled Metal Case Brooms and is the reason why *they give such excellent service.*

You Run No Risk

Performance records prove their great economy. Every Broom is unconditionally guaranteed.

We recommend our No. 426 for general factory sweeping.

We furnish Brooms for 90% of the Steel Industries; 40% of the Railroads and more than 4000 industrials whose requirements run from 1 dozen to 2500 dozen annually.

Let us supply your Broom requirements

THE JOSEPH LAY COMPANY, Inc.
Grant and College Street
RIDGEVILLE INDIANA

ORIGINATORS OF THE METAL CASE BROOM

Specialists in STAMPINGS and SHEET METAL PARTS



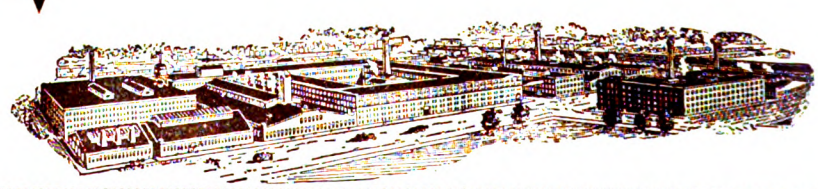
To produce STAMPINGS and SHEET METAL PARTS at the lowest possible cost requires expert workmen, skilled mechanics and ample facilities. In nine cases out of ten, the cost of Stampings made in your own plant is far too high.

Our entire plant, consisting of fifteen acres, is devoted to this one class of work—STAMPING, SPINNING, DRAWING, BLANKING, FORMING and PUNCHING in STEEL, ALUMINUM, COPPER, ZINC, BRASS or TIN.

G.P.&F. Service
Knowing How Since 81

Send us your blue prints or samples for estimates and COMPARE.

GEUDER PAESCHKE & FREY CO.
1300-1800 CANAL ST., MILWAUKEE, WIS.
DETROIT OFFICE: 712 DIME BANK BUILDING
CHICAGO: 352-358 WEST OHIO STREET



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(Continued from page 40)

the person for whom it is intended, make it an ideal sales medium. He has learned from experience that an attractively worded telegram can sell anything from plows to life insurance.

Manufacturers use it for the advantageous buying of raw materials in a fluctuating market. For the quick disposal of surplus staples it is invaluable to the wholesaler and jobber. The largest business houses daily send out hundreds of messages, frequently night letters which permit of full expression at low cost, not only for the purpose of reaching their old customers, but also for the opening up of new territory, as well as for keeping in touch with their sales forces for the effective collection of delinquent accounts and for many different purposes.

The result is that the telegraph, which in former times was regarded as an emergency expedient only, has become a more and more extensively recognized vehicle of daily business correspondence, and to keep pace with the ever increasing volume of traffic the telegraph company is constantly striving to perfect its methods and sparing no effort to render as nearly as possible a perfect public service.

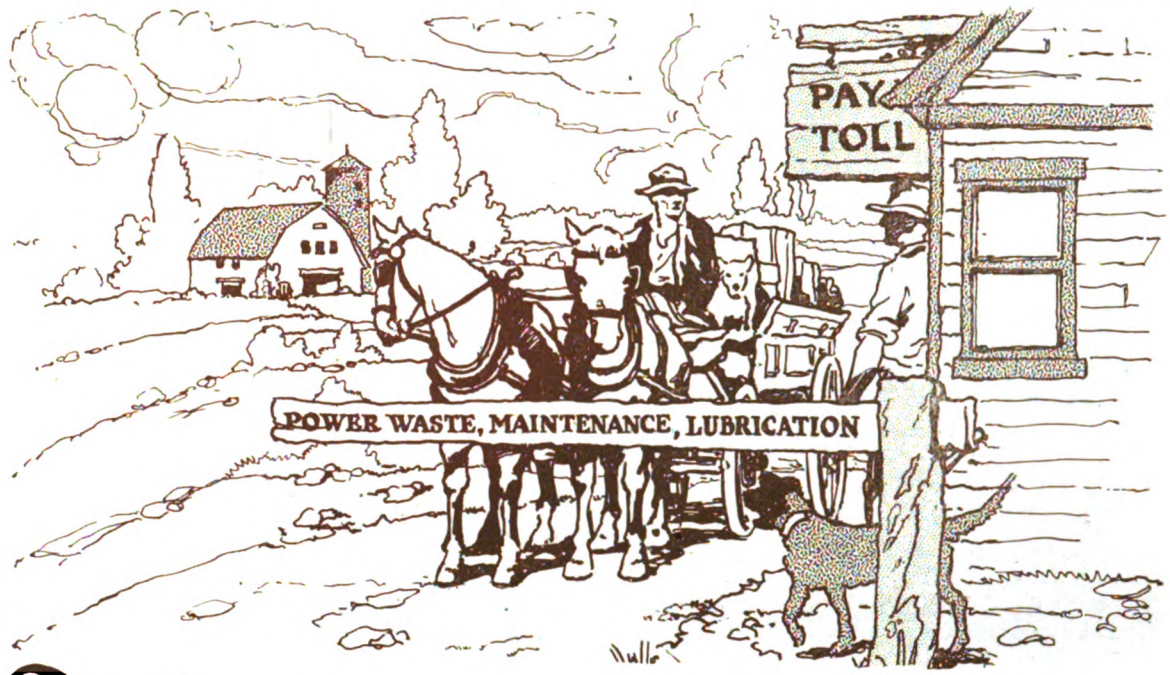
* * * *

THE history of the cable in its early days is filled with the tragedy of many failures. Many unsuccessful attempts were made to lay a trans-Atlantic cable before the first permanent one was laid in 1866. Since then many men have devoted their lives and their fortunes to make the cable what it is today, and it is to these early pioneers and the earnest men who carried forward their work that we owe the success that has finally been attained.

The earliest attempts to lay submarine cables were made either in shallow and shore waters, or across rivers. One of these cables, which was operated successfully for a short time, consisted of several cotton-covered wires enclosed in rubber and the whole then encased in lead pipe.

Innumerable experiments were made with various materials for the purpose of finding an insulator for the wire that would be not only a non-conductor but at the same time impervious to water and capable of withstanding great strain. The two insulating mediums used today are india rubber and gutta-percha, the latter being far the more preferable. A cross section of a modern submarine cable would show it to consist of a single conductor, composed of seven or more stranded copper wires, over which is an insulation of gutta-percha. This part of the cable, conductor plus insulator, is known as the core. For the sake of protection and to give it the necessary strength the core is wrapped in jute, encased in armor wire and then

Made Under SKF Supervision



The TOLL YOU PAY

POWER experts estimate that more than half of all power generated is consumed in overcoming friction. As the annual power bill in this country exceeds eight hundred million dollars, consider the staggering cost of this waste—the mountain of coal burned without productive energy. Consider also your own lessened cost of production if 60 per cent of this waste were saved and computed in the profit column.

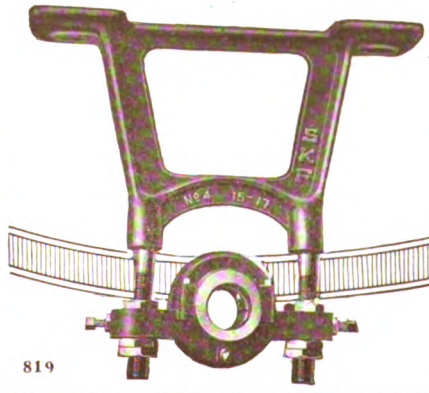
Frictional resistance, due to the binding drag of plain lineshaft bearings, absorbs a large percentage of this waste power.

Skayef self-aligning ball bearing hangers permit the shaft to turn freely even under conditions of misalignment. In more than 7,500 plants they are reducing the friction toll by 60 per cent. In the cost of both maintenance and lubrication they are saving up to 80 per cent.

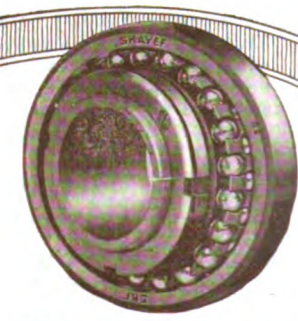
Skayef ball bearing hangers require so little attention that the maintenance man can be eliminated or put to more useful work. The cost of rebabbitting and replacing of the worn shafts is eliminated.

Oiling is necessary only three or four times a year. SKF marked self-aligning ball bearings are contained in housings sealed tight with felts, so that there can be no entrance of dust or grit, at the same time all leakage of oil is prevented.

They constitute an investment paying instant and continuous dividends in plant economy and efficiency, as well as profits. At our Showroom these facts will be more clearly outlined.



SKAYEF
Self-Aligning
Ball Bearing
HANGERS
(IMPROVED TYPE)



819

THE SKAYEF BALL BEARING COMPANY
165 Broadway New York City

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For Your Own Protection
Learn How to Tell Genuine

Linoleum

Look for the woven Burlap Back

Three Tests: 1. All genuine linoleum is made of ground cork and oxidized linseed oil, pressed on a strong, flexible BURLAP back. BURLAP gives linoleum its strength and durability, adding many years to its service.

2. Genuine linoleum is flexible and not easy to tear, because of its sturdy BURLAP back.
3. When you buy printed linoleum, be sure to get the genuine article. Make sure that the edge is *brown.*

JUTE INDUSTRIES, LTD.
320 Broadway New York City

Ask your merchant to show you the woven BURLAP back



Photo Underwood & Underwood

A strong-jawed Boatswain of the U. S. N. tows three automobiles through Boston streets in this fashion.

IT'S NOT A JOB FOR ONE TOOTH!

Such a stunt takes good teeth—and lots of them. It's hardly safe to put all the strain on one tooth, —human molar or gear tooth.

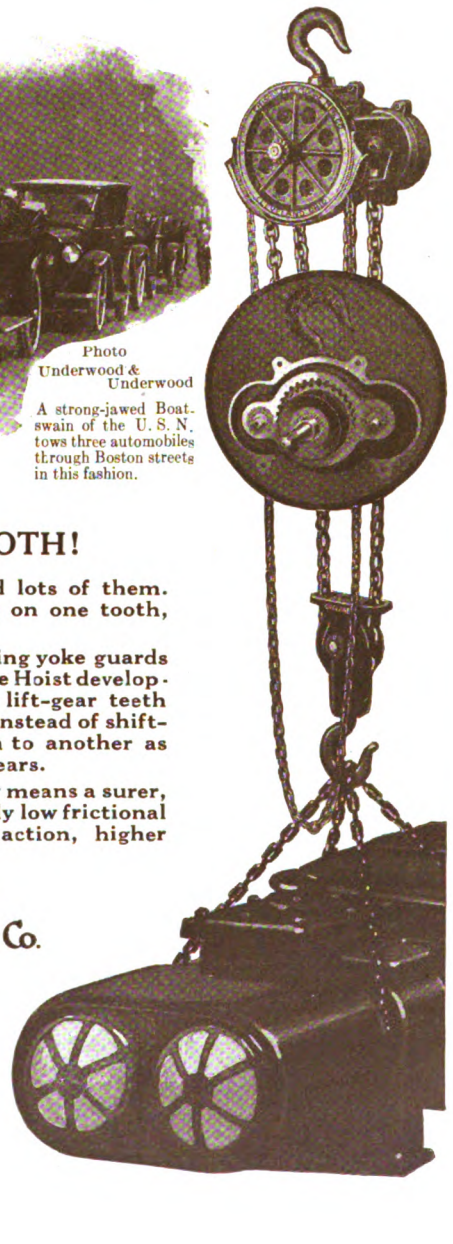
That's exactly what the C. M. gyrating yoke guards against—an exclusive Chisholm-Moore Hoist development that keeps two-thirds of the lift-gear teeth always in mesh to carry the weight, instead of shifting the weight from one single tooth to another as in ordinary circular rotating hoist gears.

This patented gyrating yoke not only means a surer, more powerful drive, with remarkably low frictional losses, but insures smooth, easy action, higher speeds and *longer service.*

Catalog on request

The Chisholm-Moore Mfg. Co.
Cleveland, O.

CYCLONE HIGH SPEED HOISTS



wound again with several additional strands of jute. The whole is then thoroughly covered with tar.

The size of the cable itself varies greatly. Shore cables are usually from 3½ inches to 4½ inches in diameter. This is necessary on account of the friction caused by tides and currents moving it forward and backward along the shore bed. The outer diameter of the deep sea portion of a trans-Atlantic cable is only about one inch, as the water on the ocean bed at great depths is practically motionless.

When a cable is to be laid, it is coiled in large circular tanks, in the hold of the cable ship, and then covered with water. The cable ship has a clipper bow and on this bow are installed two or three sheaves, over which, during the process of laying, the cable passes at a rate controlled by a regulating machine. For repairing cables the ship is equipped with delicate apparatus by which the cable is located and with machinery capable of lifting the cable (the weight of which varies from 300 to 800 pounds per nautical mile) to the surface. Other apparatus that must be carried consists of grapnels of different types, buoys, various kinds of anchors, splicing machines, etc.

At the present time there are 17 trans-Atlantic cables operated by various companies. Seven of these are operated by the Western Union, who also operate three to Cuba and one to South America.

From the days of the mirror receiver, an instrument which threw a beam of light on sensitized paper, down to the syphon recorder of the present time, is a long step that has been accompanied by many and various difficulties. To actually understand the improvements that have been made and at the same time to understand the efficiency of handling which every cable message receives, it would be well to trace a typical message going from New York to London.

The message is received in the cable office in New York, either via pneumatic tube or Morse.

Over which cable it can be sent quickest is determined by the Traffic Distributor, who has a position not unlike that of a railroad traffic supervisor. He sees that the volume of business is equally distributed and by keeping in communication with London the fault of overloading any one cable is avoided. The message is placed in one of a number of files representing the different cables and stamped by an employe with the serial number and initial representing the particular cable over which it is to be transmitted, and the date of the month. After the brief record necessary for possible reference is made, the message is then routed to the Traffic Supervisor, who places it in a container by the side of the operator.

The operator is sending on an instrument that works on somewhat the same principle as in the sending Multiplex on the land line, namely by means of a perforator and automatic transmitter. The tape passing through the perforator to the automatic transmitter, sends negative and positive currents over the cable.

These negative and positive currents actuate the coil in the syphon recorder in London. Attached to this coil is a fine glass tube, one end of which is below the surface of the ink in an inkwell, the other or needle end vibrating against a running band of white paper. As the direction of the current is changed, so the glass tube moves upward and downward, forming characters that are read by the receiving operator at the rate of about fifty words per minute. The Duplex system is used on all trans-Atlantic cables, as the Quadruplex and Multiplex cannot be used on cables of great length. However, on some shore cables the Quadruplex is largely used.

The receiving operator reads the tape and transcribes the message on a regular typewriter. When the full message has been received it is placed on a rapidly moving belt that passes in front of the operator, and quickly conveyed to a Traffic Editor who checks it and then it is routed out for delivery. Numerous inventions of recent years have advanced the cable materially. Of these, the rotary repeater,

(Continued on Page 46)

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Safety Prompted the Large Iron and Steel Mills to install "4100" GOLDEN-ANDERSON

Life and Property Insurance Valves

DOUBLE EXTRA HEAVY VALVES

"Every Valve sold With a Positive Guarantee."

"Hosts of References."

"The Heaviest Valve Made"

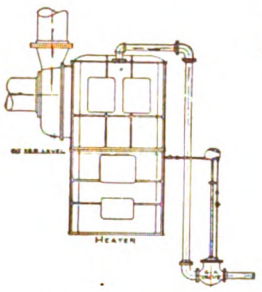
"You would do well to follow the example set by the expert engineers of these nationally known concerns. Your plant can be made equally safe."

C. E. GOLDEN.

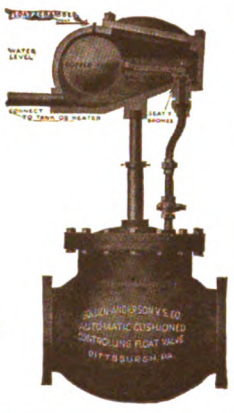
1. Automatically cut out a boiler the instant that a tube ruptures or other internal break occurs.
2. Automatically cut off the steam flow from every boiler the instant that a steam pipe bursts.
3. Automatically equalize the pressure between all boilers.
4. Automatically cut in a boiler, making accidents due to inaccurate steam gage impossible.
5. Positively prevent backflow of steam into a cold boiler.
6. Can be closed by hand, like ordinary stop valve and arranged with "combination feature" to open valve like regular gate or globe valve.
7. Can be tested in service from the boiler room floor.
8. Double Corliss Dash Pot that cushions in opening and closing.
9. Cannot pound, spin, stick or chatter.



"No Shut-Down When a Tube Bursts"



Sizes to 30 in.
Feed-Water Heater



GOLDEN-ANDERSON

Pat. Automatic Cushioned Controlling Float Valves

1—They prevent feed water waste by carrying a constant water level in the heater by controlling the inflowing make-up water.

2—Double cushioned by air and water.

3—No metal-to-metal seating.

4—No sticking or corrosion.

GOLDEN-ANDERSON

Pat. Automatic Double Cushioned Check Valves

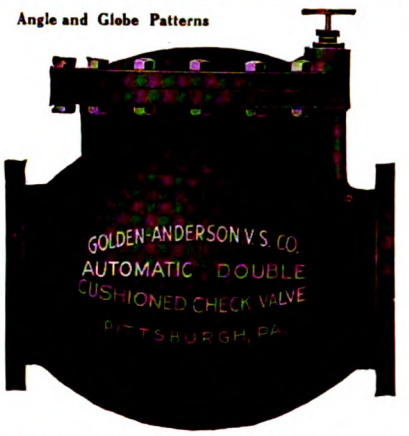
Automatically prevent disastrous reverse flow of pressure.

Especially adapted for use in discharge line of pumps.

No water hammer or shock on reverse flow of pressure cushioned in opening and closing.

Sizes to 30 in.

Angle and Globe Patterns

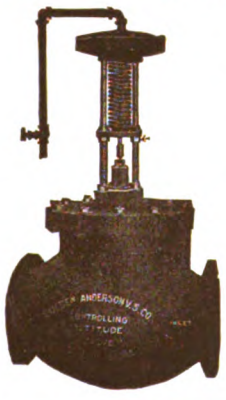


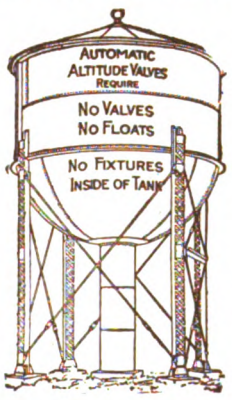
GOLDEN-ANDERSON

Patented Automatic Cushioned Controlling Altitude Valve

They should be in all supply lines to your reservoirs, standpipes and tanks to prevent water waste down the overflows.

For automatically maintaining Uniform Stage of Water in Tank, Reservoir or Standpipes. Doing away with the annoyances of Freezing and Float Fixtures inside or outside of Tanks. Three Ways of Closing "These Valves."





1st—Automatically by Water.

2nd—By Electricity, if desired.

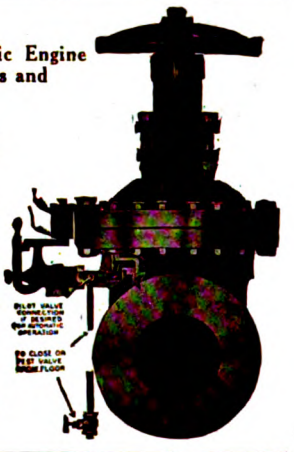
3rd—By Hand.

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so connected as to "work both ways" on a single line of pipe.

Golden-Anderson

Patent Cushioned Combined Throttle and Automatic Engine Stop Valves Provide Against Runaway Engines and Disastrous Accidents

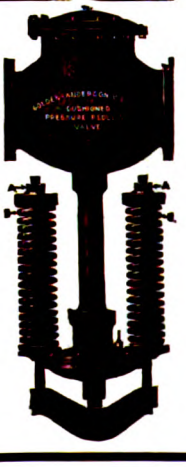
1. Pressing an electric button or opening a small hand valve from any distant point will instantly trip the valve.
2. Can be easily connected to close automatically the instant engine overspeeds by means of mechanical or electrical trip attachment. Disaster is therefore averted from this cause.
3. Cushioned by a Double Corliss Dash Pot that makes banging, chattering and sticking impossible.
4. Contains no tight-fitting parts. Supremely simple in design throughout.
5. Double extra strong in construction and virtually indestructible.



Golden-Anderson

Pat. Automatic Cushion Steam Pressure Return Valves

Safety Operating Piston makes it impossible for high pressure to enter into low pressure service. Makes accidents impossible.
Thoroughly cushioned—no hammering, chattering or striking.
No auxiliary valves or small by-pass—reliable and uninterrupted service.
Double extra heavy throughout—practically indestructible.
Only one adjustment—on the outside. Valves always accessible.



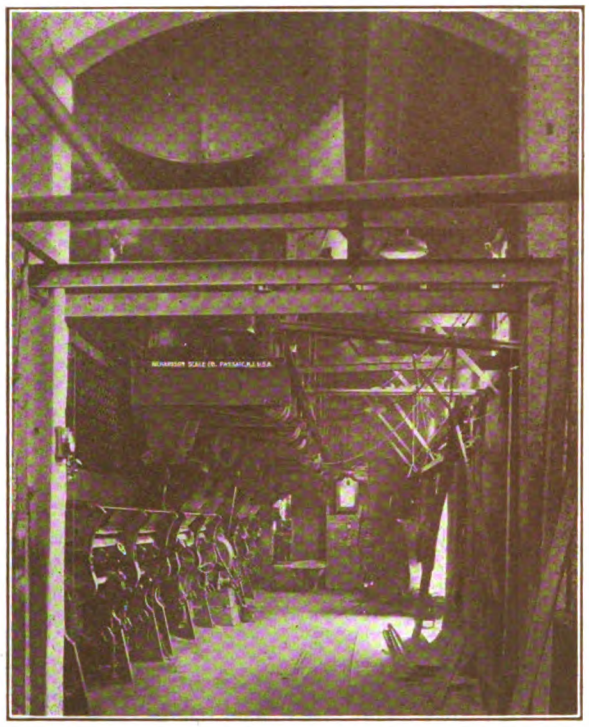
GOLDEN-ANDERSON VALVE SPECIALTY CO.

1306 Fulton Building, Pittsburgh, Pa.

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Keep Your Eye On The Coal Pile

Power Costs Can Be Kept Down By Burning Coal Economically



A Richardson Automatic Coal Scale

Gives You the Control You Need Where You Need It Most

If a boiler isn't giving you the best efficiency, it will burn more than the usual amount of coal. The trouble may be due to soot, scale, holes in the fire or other cause that can be quickly detected, if you know exactly how much coal each boiler is using.

With 65% of your power costs figured in dollars and cents for coal, what would it mean to you to discover this waste, before it has a chance to dig into your profits?

The RICHARDSON is an entirely choke-proof machine. Weighs easily and accurately any kind of coal. Receives the coal automatically from overhead bunker, weighs it, and delivers it in a steady even stream to stockers.

Send today for Bulletin 4122-A

RICHARDSON SCALE COMPANY

Passaic, New Jersey

New York Boston Buffalo Chicago Minneapolis
Omaha Wichita San Francisco Memphis Atlanta

(Continued from Page 44)

originally developed on land lines, plays so important a part with the cable that it is worthy of special notice, for it made possible the direct working between New York and London without the use of any intermediate relay. Had it been developed several years sooner it would have been possible during the World War for President Wilson in the White House to have been in direct communication with General Pershing on the French Front.

What Ford is Doing and How He Does It

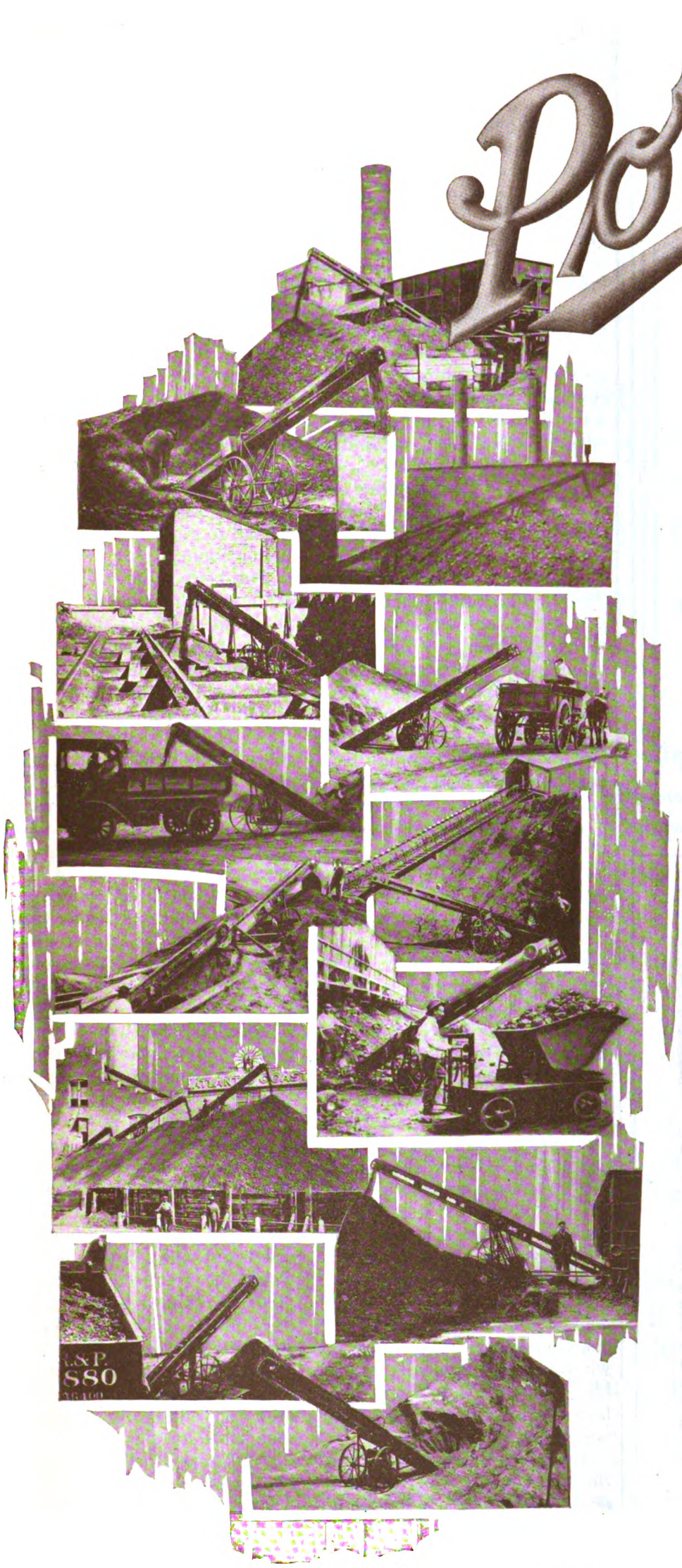
(Continued from Page 13)

tions also. This first section deals with departments of Industry not commonly parts of a metal-working plant. It takes one over the "High Line"—the concrete viaduct forty feet high and three-quarters of a mile long that forms the backbone of River Rouge, past the twelve million ton capacity concrete storage bins that skirt the River Rouge slip; it takes one through the coke ovens and through the by-product plant where fuel for melting ore and pig iron is produced and where coal gases are transformed into tar, fertilizer, illuminating gas and motor fuel. Other sections in later issues will take our readers on similarly personally-conducted inspection tours through the blast furnace plant and foundry—the latter the largest in the world—through the enormous power house whose equipment is the last word in economical power production, and again through the machine shops and assembling plant with their mechanically moving "lines" or pace-making conveyors.

Substantially all of the equipment at River Rouge that is shown on the pages of this issue is devoted to coal. Literally speaking, a river of coal flows continuously through this plant. How vital this supply is to plant operation has been recently impressed upon the public. Two thousand tons of coal per day are required at River Rouge for the coke ovens alone. Bear in mind when considering this figure that these coke ovens and the by-product plant that utilizes their gases are operated not as "commerical side lines", but as direct steps in the manufacture of Ford cars, trucks, and Fordson tractors. Thus, the coke produced in the coke ovens is used for melting ore and pig iron in the blast furnace plant and the foundry; the tar extracted from the gases of the coke ovens is used as a fuel in heat treating or other furnaces; the light oil extracted from these gases gives "motor benzol" used for motor fuel and also for making artificial leather for upholstery, and the illuminating gas which is the final by-product is largely used for core oven and industrial heating. The only "unusable" product is the ammonium sulphate or fertilizer, which is sold as is a small percentage of excess of illuminating gas and an equally small percentage of the smaller screenings of coke. Fundamentally, however, the coke ovens and the by-product plants are as directly used in Ford car and Fordson tractor production as are the Ford foundry and machine shops.

The key-note of coal utilization is uninterrupted transportation, as will be noted from the accompanying pictures, and surely transportation becomes a pressing problem when daily quantities such as two thousand tons of coal, fifteen hunderd tons of coke, ten thousand gallons of benzol and twenty-two million feet of illuminating gas are involved. A break in the transportation chain would undoubtedly mean stoppage all along the line, the only alternative being a tremendous piling up of materials. The engineering talent applied in laying out this transportation system has been of such high order and the equipment so well chosen for its purpose that the flow of materials continues hour after hour and day after day without interruption.

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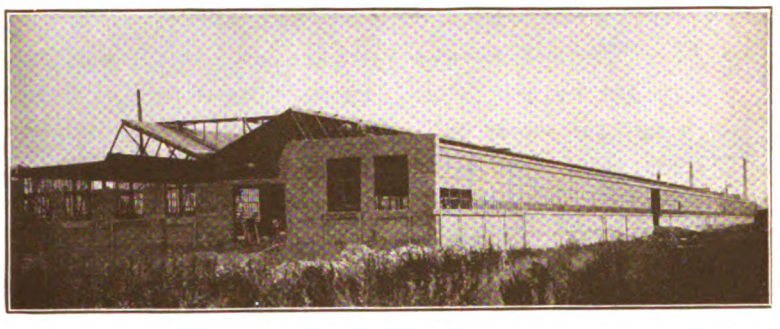
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Oil, As A Fuel for Steam Power Generation

(*Continued from Page 18*)

things that have become accepted as right, in the field of power generation.

When we first started to burn bituminous coal for steam power generation, about all we knew about coal was that it would burn, and that it gave off a steady, intense heat, and that there was practically an inexhaustible supply of it. Some inquisitive men of science came along and discovered that bituminous coal could be made to yield gas, tar, ammonia—a long series of products of inestimable value—and still leave a fuel, coke, which was better fitted for burning than the original coal. Then, with the tremendous growth of the steel industry—which is absolutely dependent upon coke—it became more than ever plain to thinking men that the burning of bituminous coal was an economic crime. But by that time, we had been using the raw coal as fuel long enough to become thoroughly steeped in tradition—that bugbear of progress. And we will probably go on burning raw coal until we, collectively, get sense enough to coke it and extract the by-products; a thing which will probably be hastened by the ever-increasing demands of the steel industry for coke. Incidentally, when coal is treated for by-product recovery, one of the by-products is motor benzol, which must before long be counted on to eke out our dwinding supply of gasolene. Logically, then, every bit of our bituminous coal should be treated for the recovery of by-products; the steel industry should have first call on the coke thus produced; and industrial power should come from the balance of the coke, plus the use of fuel oil wherever economically possible, plus an intelligent and large-scale development of our water-power resources.

Meanwhile, having gone into the question of what coal can do—what does oil, fuel oil, hold in the way of immediate promise under existing conditions?

From the time it comes out of the ground until it gives up its heat under the boiler, oil approaches far more nearly the engineer's idea than does coal. Instead of being loaded, handled, unloaded and re-handled half a dozen times between producer and consumer, oil is pumped through pipe lines from the wells to the refineries where it is distilled. From these refineries the fuel oil is shipped in tank cars to the consumer—and a flexible pipe carries it to storage tanks, while either gravity or small pumps carry it through pipes to the burners. The whole thing involves a simplicity that is marvellous in contrast to the huge agglomeration of machinery and man-power required to get coal from mine to boiler room.

The heat value of coal runs from nine thousand to fourteen thousand B. T. U. per pound, while fuel oil runs between eighteen and nineteen thousand B. T. U. per pound. It should be remembered, too, that efficient combustion is more easily attainable with oil than with coal. Boiler efficiencies, with oil burners, range from seventy to eighty per cent., which is equal to the best efficiency attained in a well managed coal-fired boiler; and with oil, there is less chance for inefficiencies to creep in through laziness or carelessness on the part of the operating force.

The chart shown on the opening page of this article offers a ready means of finding out what fuel oil can be expected to do in any given power plant. If you know (as you should) what the B. T. U.—content of your coal is, and what efficiency you are getting, it is a simple matter to find by means of the chart not only how much oil would be required to accomplish the same result, but also the dollars and cents comparison between the two. In other words, knowing the price of your coal and the price of fuel oil delivered at your plant, you then have an accurate idea of the difference in the cost of the two fuels.

Having gone so far, the rest is not a matter of charts, but of individual conditions. The saving in boiler-room labor charges with oil-fired boilers ranges from practically nothing in small power plants, to a-

(*Continued on Page 51*)

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Scarcity of labor is already in sight. Efficient workers, as a rule, are now employed.

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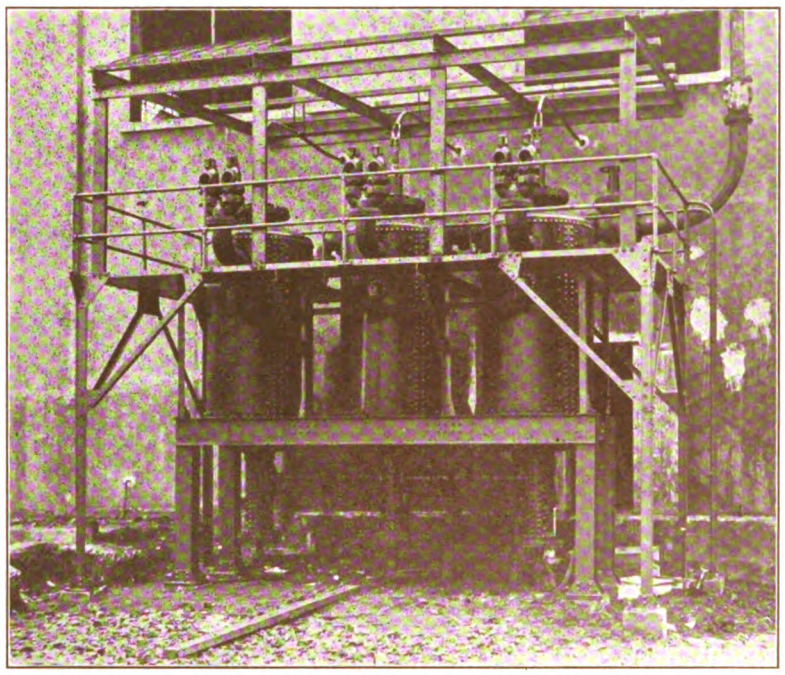
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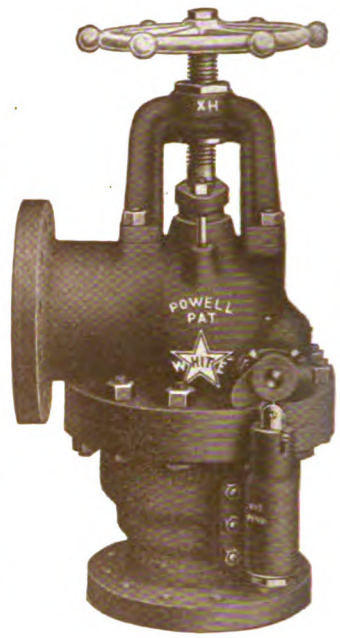
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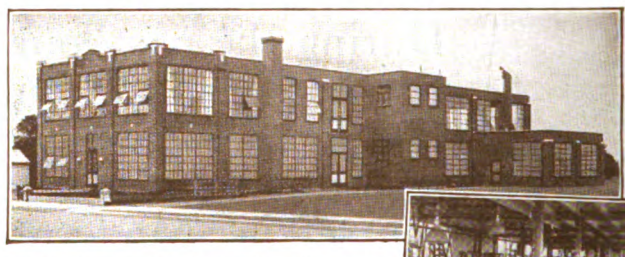
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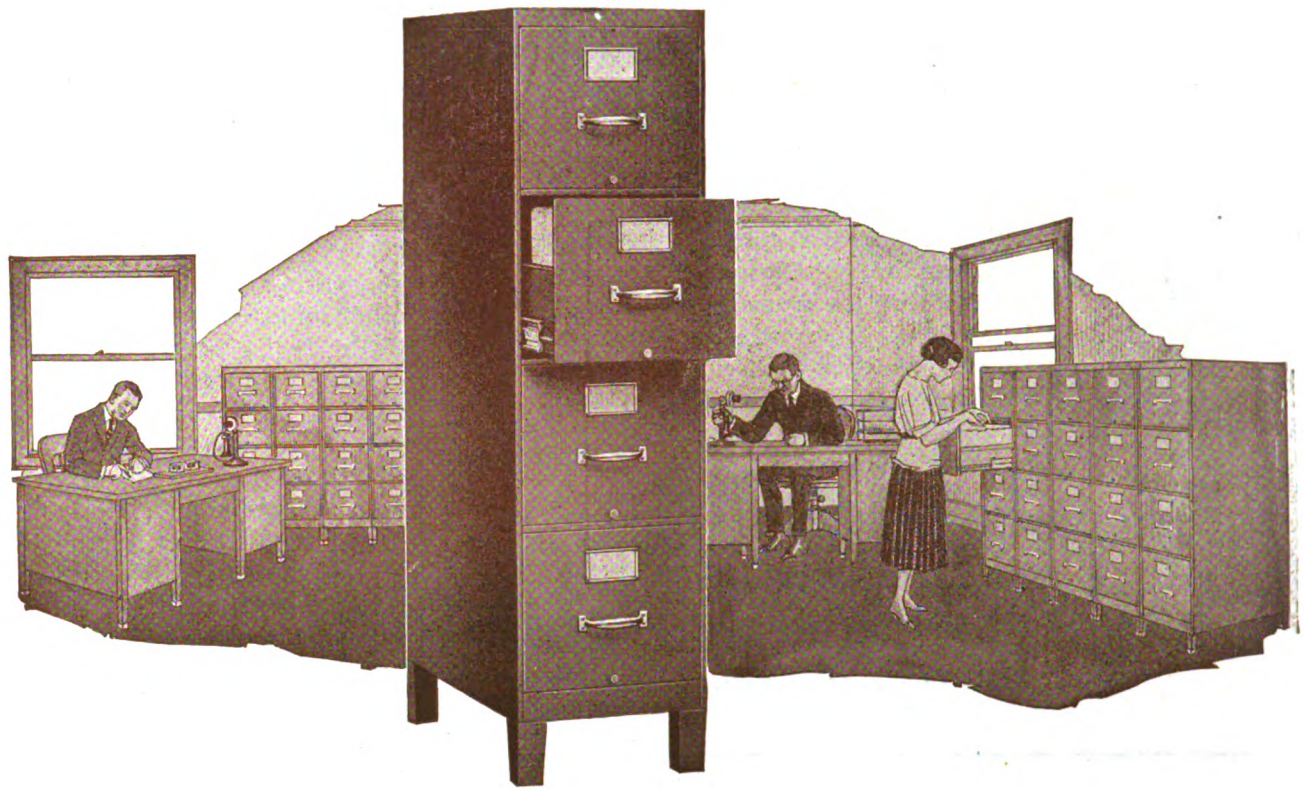
much as sixty percent in central stations and large plants. The saving in cost of getting the fuel from railroad siding to boilers, on the other hand, is often greater in small plants than in large ones; because the smaller plants employ labor for this purpose, while the large ones use mechanical conveyors.

Having taken these factors into consideration, we must pry more deeply into the particular requirements of your plant. Have you a fairly constant demand for steam, or are there sudden, heavy peak loads?—because oil burners can respond almost instantly to heavy demands, without continuing to burn up fuel after the demand drops. Is it necessary to bank your fires?—because a banked fire burns up fuel, while oil burners can be shut off; and it takes no longer to start cold, with oil, than to start from a banked fire, with coal. Also, in most cases, it is possible to increase the boiler capacity merely by installing oil burners in place of coal grates; so that there are occasions when the installation of oil burners will save the cost of additional boilers for a needed increase in power.

There are both skeptics and enthusiasts on oilburning, as well as on every other subject under the sun. The skeptic harps on the growing scarcity of oil (which, as a matter of fact applies only to those oils from which gasolene is derived, and not to the crudes which yield fuel oil) and asserts that oil-burning is only an experimental fad. The enthusiast makes wildly extravagant claims and says that coal cannot begin to compete with oil. The truth lies about midway between these extremes: oil-burning *has* passed the experimental stage, but there are cases where it cannot economically displace coal—as witness, on the one hand hundreds of plants successfully burning oil, and on the other hand hundreds of plants which after full investigation continue to burn coal. And whether it would pay you, in your plant, to burn oil—is a matter dependent not at all on what anybody else says has happened in some other plant, but is dependent upon individual facts easily ascertained.

Ultimately of course we have got to look at the whole power question in a much broader light. When the rank and file of us once see that cheap power is the only key to progress, that it holds the solution to all of our vexatious social and political problems—then, and only then, will we look upon coal and oil and running water with a proper perspective. Until that time, we can only muddle along and meet the needs of the present. We cannot afford to scrap all the money investment in boilers, stacks, engines and so on. We cannot overnight change our whole industrial scheme as it must some day be changed, but must gradually work toward the ultimate goal.

An encouraging sign, is the fact that there is more real interest today than ever before in our natural resources. We have begun to look at coal, not as so much black stuff to be burned for heat and power, but as nature's great gift to man—



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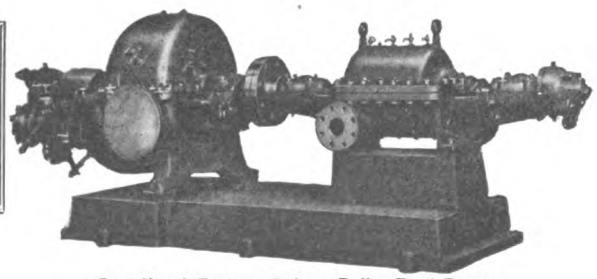
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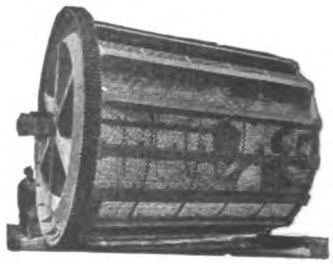
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a gift which man must use sensibly and to the full of its potential benefits. We have even begun to question the rightness of our present paths from natural resources to delivered power; to wonder, as our knowledge increases, whether there is not a more economical path. The real problem is to find the shortest, most efficient path from these resources—oil, coal, water (and sonte perhaps as yet undiscovered source of energy)—to power for the use of mankind. And when we assume that broader viewpoint toward oil, it leads us along a different path from the coal path. We know of no practical way to release coal's energy for power, except by generating steam. Oil, on the other hand, offers another path to the real goal, which is *power*—the internal combustion engine. It is our purpose to take up in succeeding articles the present state of progress and accomplishment of the so-called Semi-Diesel engine and of the radically different Diesel engine; to show what these types have done and are doing as a contribution to the power needs of industry. Because no consideration of oil—as a source of power—would be complete without taking in the very real and important accomplishments of this type of prime mover.

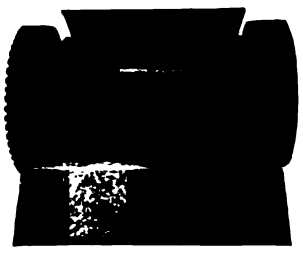
"WE make too much of the idea that 'modern industry has destroyed the personal relations.' It is full of personal relations, at every turn and in every hour of the day, but the points of contact have shifted. One might suppose that industry runs itself, by some malevolent guidance of blind force. It is, in fact, ourselves at work. It is none the less human in every pulse and breath because there are ten thousand of us at work in a common enterprise instead of twenty-five. All through the process the individual workman, if he is not in contact with the stockholder or the director or the general officer, is at any rate in contact with someone in the directing capacity who stands to him in the relation of stockholder or director or general officer."—Hayes Robbins, in *The Making of Tomorrow.*

PUZZLING Reduction Problems Occur in Almost Every Industry

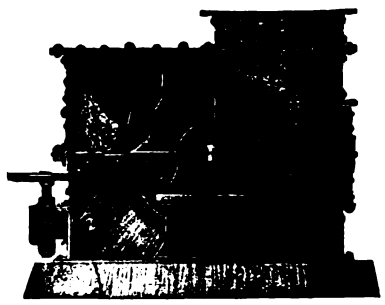
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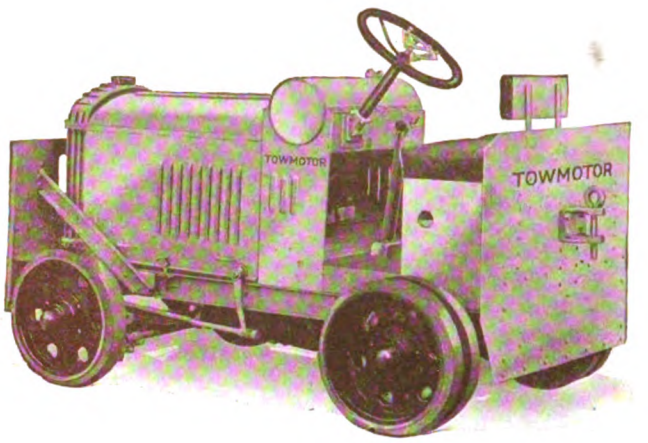
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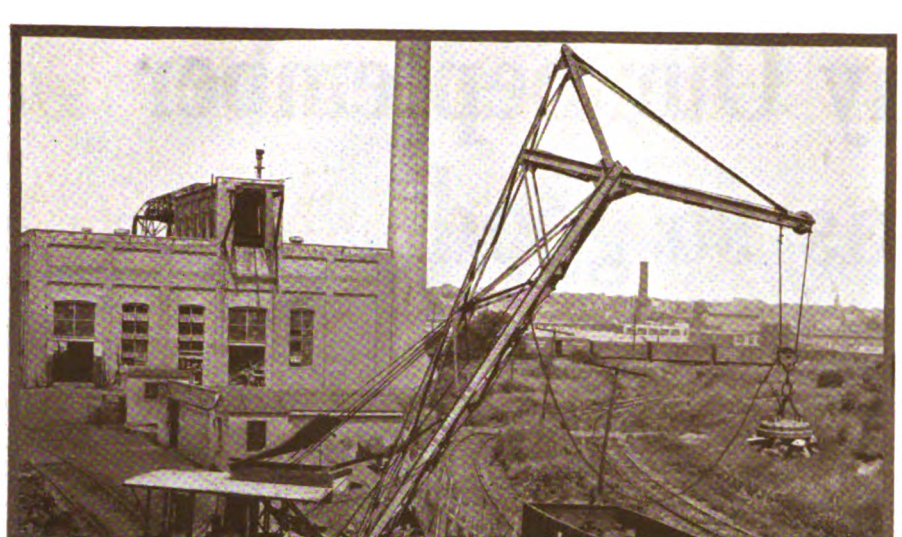
THE TOWMOTOR COMPANY

1226 East 152nd Street **Cleveland, Ohio**



THE TOWMOTOR

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P & H 206 Gasoline Crane equipped with Gooseneck Boom unloading pig iron o stock pile in yard.

Same machine may be equipped with straight boom or shovel.

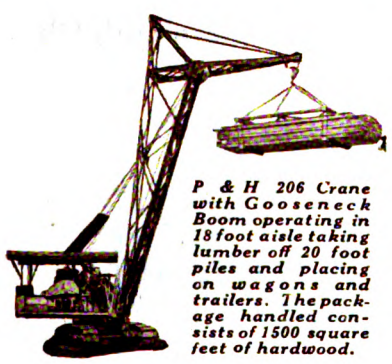
The P & H Has Unlimited Usefulness

The usefulness of the P & H Gasoline Corduroy Crane in any industrial plant is almost without a limit.

Equipped with a crane hook it can be used for loading and unloading machinery, handling structural materials, castings, flasks, etc. By hooking on a magnet the crane is used for handling pig iron, scrap or any magnetic materials.

With a clam shell bucket it handles moulding or core sand and coke at the foundry or coal at the power house.

Because no track is required the machine can be used in any part of the plant. Since there is no objectional smoke, the crane may be used indoors as well as out doors.



P & H 206 Crane with Gooseneck Boom operating in 18 foot aisle taking lumber off 20 foot piles and placing on wagons and trailers. The package handled consists of 1500 square feet of hardwood.

The wide range of usefulness and mobility of this machine combined with its low fuel consumption, one man operation and ability to start and stop instantly assure a constant return on the investment even in small plants.

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P&H GASOLINE CRANES

The Making of Watch Crystals Now An American Industry

(Continued from Page 25)

of machine designs, to the point where most of the various operations are performed by semi-automatic machines. The custom in foreign manufacture is, or was, to do many of the various operations by hand. American inventiveness has provided machines, designed as the infant industry developed, to take the place of this costly hand method.

It might be here stated that another obstacle cropped up when the new industry was fairly under way. This was Japan. In 1915 Japanese exports to the United States in watch parts were around $96. This represents crystals. In 1918 they amounted to some $300,000; also practically all crystals. However, this class of crystals proved more or less unsatisfactory. The Japanese had not mastered the art of making clear, flawless crystals. They showed a tinge of straw color, and were unsuitable for the high grade watches.

During the early period of the struggle, the concern expended over a half million dollars in experimenting and learning how. Today they have a daily capacity of 800 gross of crystals, of all sizes and designs used in the trade.

This is despite the fact that it takes one and one-fourth crystals processed to produce one finished article, due to the rigid inspection and the breakage during the various operations. In the beginning, the proportion was two and six-tenths crystals processed to one finished and passed.

It must be borne in mind that watch crystals as applied to high grade watches must have a flawless finish, be perfectly clear and colorless, and be gauged to thickness and diameter. As in any working of glass, many complications occur in its melting, blowing and forming.

The base of the glass used is silicate rock ground to about the fineness of sea sand. This silicate is secured from Pennsylvania. To this are added lead, alkalies and various oxidizing agents that experience has proven necessary. This compound is used with an equal amount of cullet, glass that has been previously compounded and melted. The latter is the remains of previous batches that have been already blown.

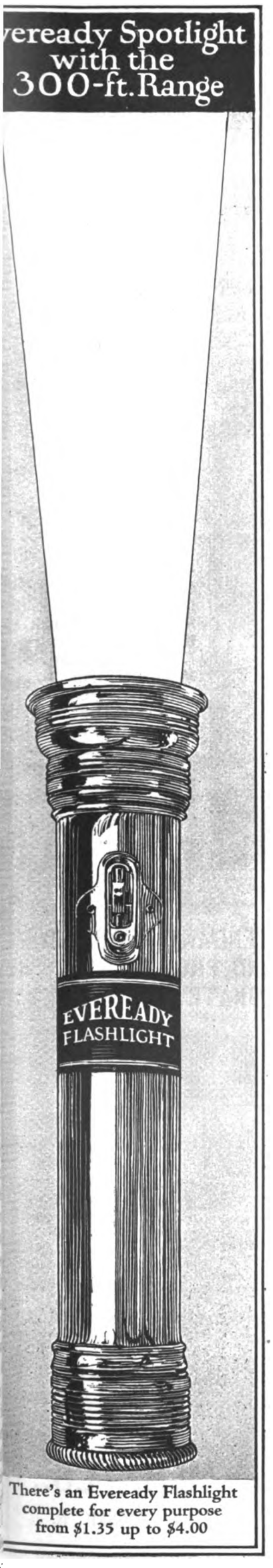
The compound that forms the glass is melted in huge covered pots formed of clay. These pots weigh approximately 3,000 pounds. They hold a batch of about 2,400 pounds at a time. The pots are made from imported clay and are received unbaked. The crucible is preheated five or six days in a temperature of about 1,800 degrees. This is to bring it gradually up to its working temperature. It is then transferred to another furnace where the material is added from which the glass is formed. It takes about eighteen hours at an even temperature of 2,400 degrees to melt the compound. The glass is ready then to be blown. This pot will last from one to several weeks and then must be discarded. It all depends on how the pot withstands the intense heat.

The molten glass is gathered on the end of a blow pipe and blown free-hand. No molds are used, as contact with the mold would be liable to cause imperfections in the globe formed. The blower blows into mouth to start the sphere he desires to form. The pipe is then laid on a horizontal rack and the mouth end shoved into the opening of an air line. The blower then sits on a small bench, his foot on a pedal that controls the air, and rolls the pipe back and forth on the rack until an almost perfect sphere is formed. They are blown to ten and twelve inch diameter.

The resulting product is a globe of clear colorless glass of the thickness necessary for the crystals to be formed from it. This thickness, however, is not strictly uniform. The globes run somewhat thicker at the end where attached to the pipe and thin at the further pole. The intermediate glass forms the crystals and also proves slightly variable. The globes are blown with a surface finish, highly polished from the heat, and if passed are free from bubbles, streaks

(Continued on Page 56)

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Specific Uses for Eveready Flashlights in factories

1. **Indispensable in stock rooms** — to read labels on barrels and boxes in dark corners, on shelves, in drawers
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6. **Inspection of equipment**—sprinkler heads and other appliances can hardly be thoroughly inspected without a flashlight
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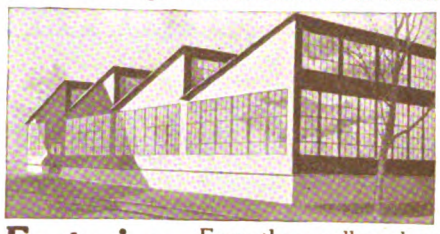
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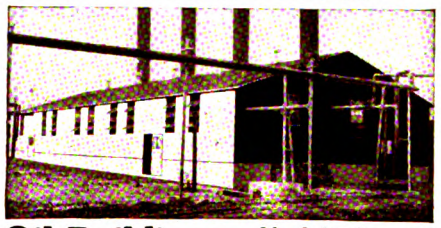
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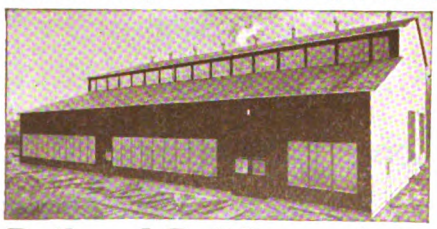
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TRUSCON STEEL CO.
YOUNGSTOWN, OHIO

Memo to write to Truscon Steel Co., Youngstown, Ohio, telling them our building problems

(*Continued from Page 54*)

lines, or discoloration. They look very much like a finished product, even in this first operation. The blower frees his pipe from the globe by running a pair of wet tongs around the neck, close to the pipe, and releasing it by a slight tap. The globes are then placed in a rack, set on the floor, to cool. The blower then repeats the operation until the quantity workable is taken from the pot.

One-half of the contents of the pot is used, and two pots are run off a day. The remainder of the material does not work up successfully and is discarded for the time being. This is done by ladling the melted glass into a huge iron caldron full of water. This cools the glass, which breaks up into fragments that range from the size of a walnut down to minute pieces. These fragments are ground up and form the cullet which enters into the formation of another batch, as previously described.

The globes now go to a cutting bench where they are split in two halves. This is done by inserting a curved glass cutter through the opening where the blow pipe was attached, and scoring a line about an inch long toward the opposite hole. A slight tap breaks the glass in line with the cut, and a further tapping around the surface of the globe divides it neatly. This latter operation is a knack that took a long time to master. Thousands of globes were shattered beyond use before the operator was enabled to do it efficiently.

It might here be further stated that the Company was forced to train their help from the very beginning. Intelligent factory labor was taken in and painstakingly instructed. The force learned as the staff overcame obstacles and educated them to the knowledge and experience gained.

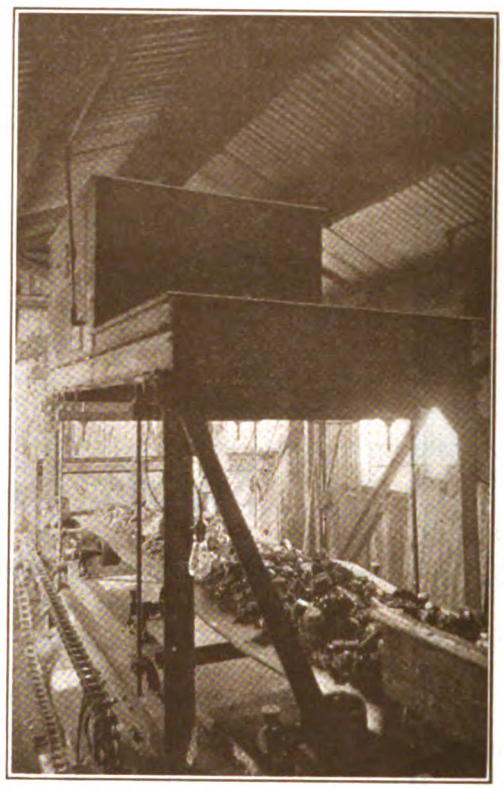
This lack of help also extended to the glass blowers. There are few free hand blowers in the country today, and those capable of blowing the quality glass suitable for watch crystals are rare. Mere glass blowing won't do. Watch crystal blowing is required.

After splitting, the halves go to a machine where the crystals are cut from these sec-

(*Continued on Page 59*)

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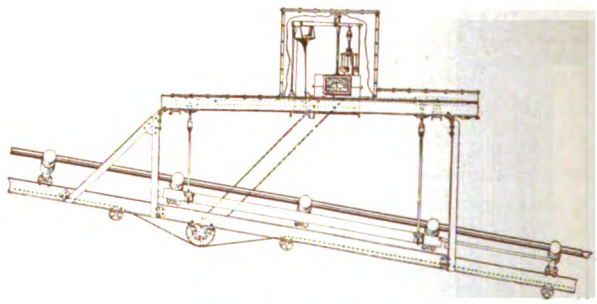


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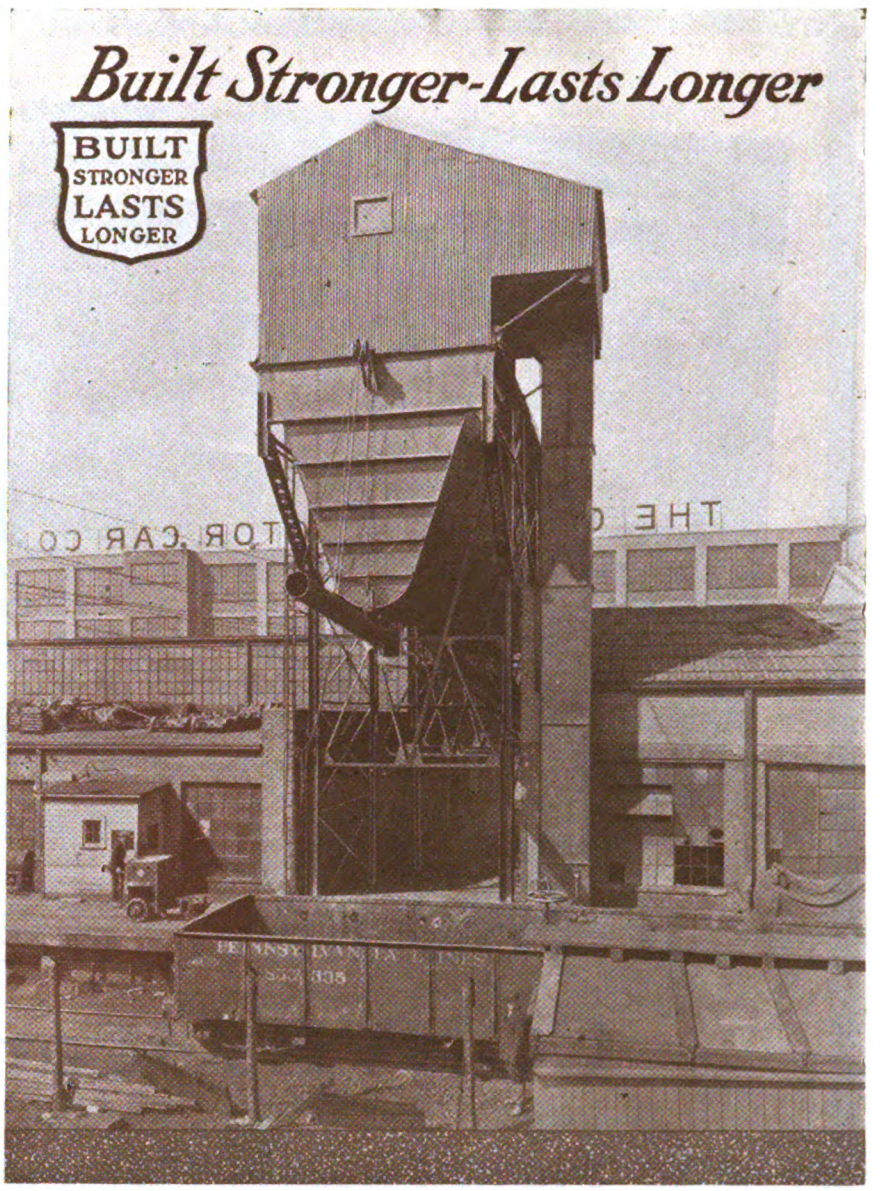
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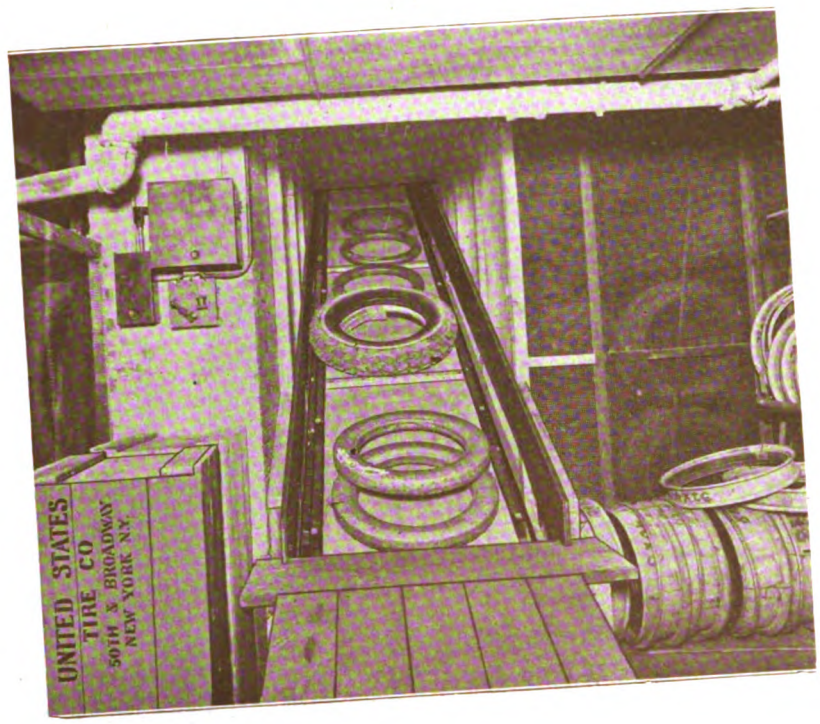
If you're contemplating the erection of a new power plant or additions to an existing plant, you'll be interested in the money-saving features of G-W Coal and Ash Handling Equipment.

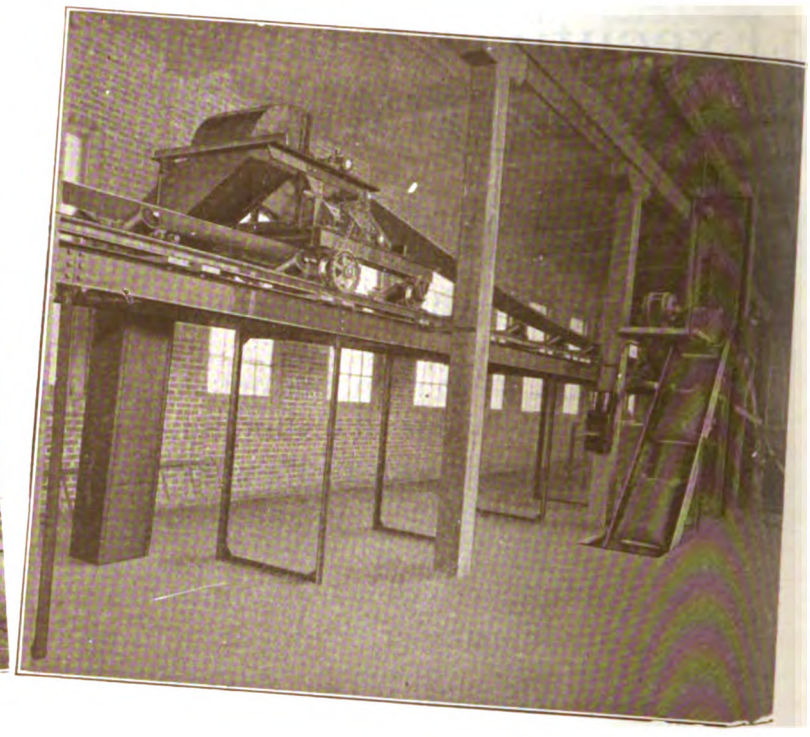
Such power plants as the Chandler Motor Car Plant pictured above, the Manhattan State Hospital Plant, Ward's Island, N.Y., and other representative plants throughout the country, present concrete evidence of the "Built Stronger—Lasts Longer" advantages of G-W Equipment. A Gifford-Wood representative would like to give you complete details.

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(*Continued from Page 56*)

ons. The radius of these lves forms the curvature of e finished crystals in the low- priced watches. They are own as Miconcave, as con- asted to Empire, Lentilles, d Geneyas, which classify e higher grades. The Len- le is a specially formed high ade crystal that is used on pensive watches. Genevas e a thinner model, Empires medium grade.

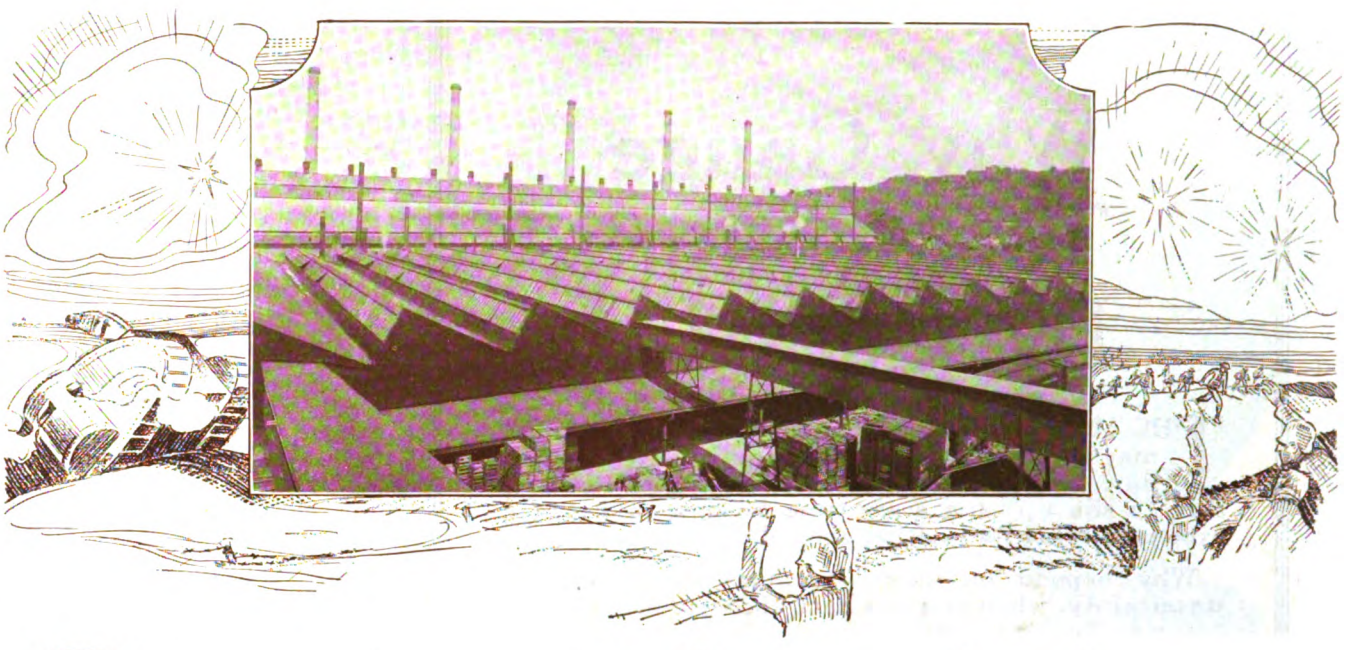
The machine that does the tting is a simple bench affair orked by hand. It consists an upright pedestal and ex- nded arm through the end of hich drops a vertical bar. At e bottom of this attachment a horizontal bar holding a ass cutter at the end. This r is adjustable. It can be ar- nged to scribe a small circle r wrist watch crystals, or tended to form the larger zes.

The operator holds down th a slight pressure on the rtical bar and scores a circle th the cutter. This is re- ated until the half globe, or rtion of a half, is filled. A ght tap frees the blanks thus arked.

There is now a round crystal, lly polished on the surface, th approximately the diame- desired, and with the con- x surface sought if to be used low priced watches. These t out crystals now pass along inspection bench and are spected for flaws before suc- eding operations are per- rmed. They are gauged for ckness by a dial gauge, di- led to read thousandths of inch. The crystal is placed tween the indicating plunger the dial and an anvil below. e reading is somewhat on the inciple of a micrometer cali- r. The crystals are placed several piles as they are uged, which are later graded r various uses.

The next inspection is for rfect flatness of the edges. is obvious that the blowing es not form a perfect sphere, r the cutting out of the crys- ls work uniformly. The ystal is laid on a small square glass and if it rocks it must reheated and leveled in a ess, which levels the edges. bout forty percent prove ac- rate; the remainder must un- rgo the further treatment. This flattening is done on a pe of machine that is formed somewhat on the style of the cutting device. In this opera- tion the crystals are placed in a small mold or die and placed in a muffle. All reheating is done in muffles as direct flames would discolor the glass. When properly heated the molds are removed and placed under a plunger or forcer worked by hand. This is pressed down on the crystal and levels the edges. The crystals are then annealed to prevent tension strains.

Another reheating and press- ing operation is performed on the higher grade crystals. Crystals formed from the blown globe, as stated, are mostly for low priced watches and the globe curvature is sat- isfactory. The finer crystals are placed in molds as in the



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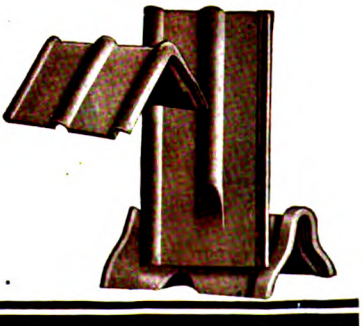
Over the top! — Bonanza "Cementile" knows no dread of the unending zero hour all roofs must face. The elements are impotent, fire cannot injure, for a Bonanza "Cementile" Roof is impervious to these forces of destruction.

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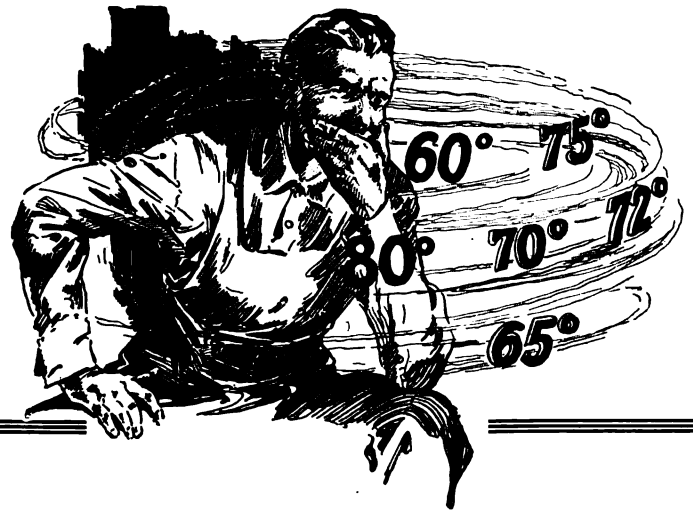
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preceding operation and formed to the shape desired. In this the crystals are flattened on the surface, and in fact are also pressed inside out. This results in a crystal with a flat surface and a curve or bend at the edges. The product is a crystal that will fit into a watch, be free of the hands, and yet show a flat face. Trade demands may require them to be flat, slightly convex, or of any degree of curvature in use.

The next operation is grinding. All crystals must be ground and polished on the edges. This is done on semi-automatic machines. The abrasive used is either pumice stone, or sandstone wheels. On the cheaper grades, or thicker crystals, the glass is placed between two centers or rubber tipped plungers, which are swung after the fashion of those on a bench lathe. These small lathes are mounted in series on a long machine base; one man taking charge of twenty machines. The crystal is held taut by spring pressure and is placed against a horizontal grinding wheel.

The action of the wheel, to which the edge of the crystal is held firmly by a tension arrangement, trues up the blank and grinds the edges on the necessary bevel. The ground bevel is formed by setting the centers which hold the crystal off on the angle desired. As soon as a crystal is ground to the proper diameter a small electric light over the machine goes out and an attachment throws the centers holding the crystal, away from the wheel. The operator then takes out the finished work and replaces it with another glass to be ground.

Another form of grinding, performed on the finer grade crystals, is done on a machine somewhat on the lines of the one described above. But this machine uses a vertical wheel which travels back and forth across the edge of the crystals. The action is similar to a cylinder grinder. Two crystals, held back to back between two centers, are ground at once. This is possible on account of the edges being ground straight, and a thinner crystal being used. The grinding on this type is to bring them to the proper diameter. Four thousandths is allowed as variation either way from the fixed size.

From this machine the high grade crystals go to another grinding machine, which forms a curved edge to the glass. As previously stated, this type Lentilles, Empires, and Genevas, are pressed with a band at the edges. This band breaks rather sharply from the pressing operation and the second grinding is to form a graceful curve which merges into the flat or convex surface of the crystal. This grinding is done by attaching the crystal to the end of a tube, to which it is held by suction, and allowing the crystal to drop gradually down over the face of the grinding wheel. The descending motion, in connection with the circular movement of the crystal, forms the desired curve.

After this curve is formed it leaves the crystal with sharp bottom edges and dull sides. The edges at present are dulled by holding them against a sandstone wheel and slowly turning the crystal in the hand as ground. Machines are in process of construction to do this operation semi-automatically. It is now necessary to polish the dulled glass. This is done on buffing wheels, using red rouge.

The lower priced grades must also have the sharp edge removed and the bevel polished. This is done on an ingenious machine which works practically automatically. A finger picks up the crystal from a stack and places them one by one between an upper and lower dial pin which is set on a dial plate. The plate revolves horizontally and contains several sets of pins. The crystal is held between the two pins by tension, and trues itself by a guide set beside the revolving dial plate. As the dial circles, the crystal first rubs against a strip of emery cloth, which dulls the edges, and then works against a horizontal wooden wheel, flushed with pumice stone and water, where it receives the necessary polishing.

After polishing, the crystals receive the final inspection. They are then either placed in stock, shipped to the various watch manufacturers, or utilized in the local watch plant.

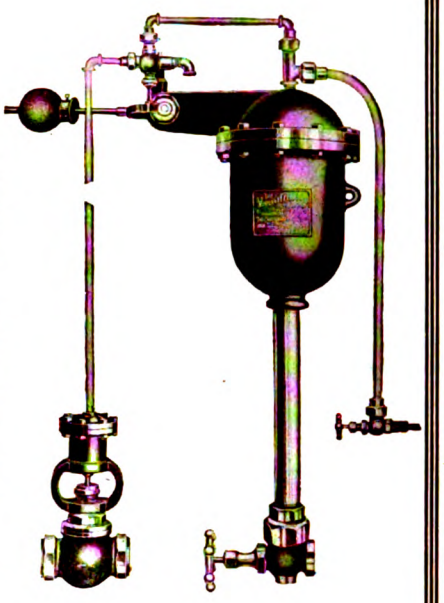
At present the company is making crystals that range from the smallest wrist watch

(Continued on Page 62)

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Save Fuel and Make the Boilers Safe

Install a Vigilant Feed Water Regulator



and keep the water-level within one-fourth inch of center-gauge regardless of the load or method of firing.

The Vigilant has no floats, no complex system of levers, toggles and small valves, no concealed parts or obscure steam passages. Nor does it depend upon the uncertainty of expansion and contraction. FREE TRIAL.

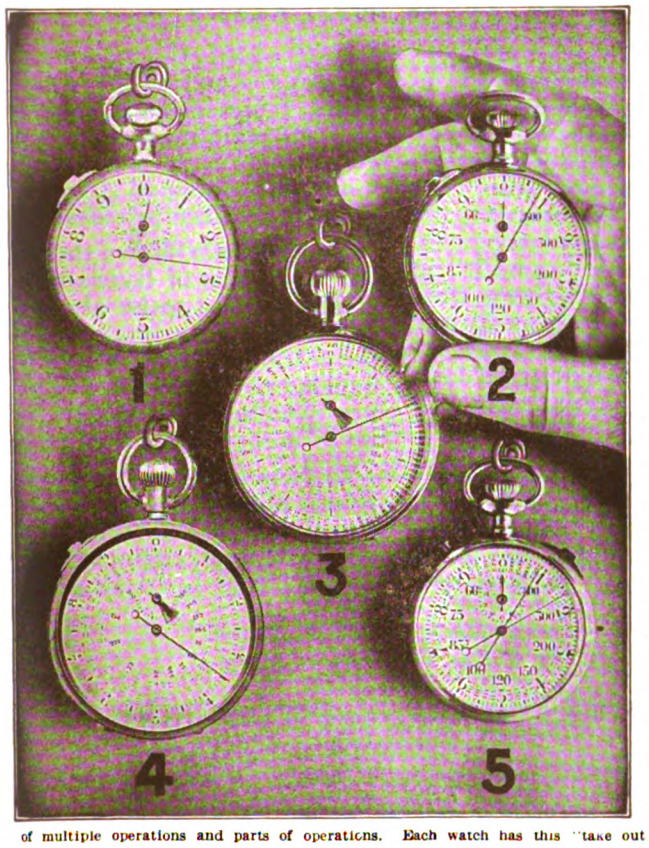
Write for free descriptive circular.

The Chaplin-Fulton Mfg. Co.

28-36 Penn Ave. **Pittsburgh, Pa.**

Also Manufacturers of the Fulton Pump Governor, Tank Governor, Reducing Value and Other Steam Specialties

At Last Time Study Watches for Every Job



At last time study watches have been developed to where they can apply to every job in the plant—do their own calculating for production figures—give you direct results with absolute accuracy. Your job may be a simple time analysis—or a complex problem in piece work rate setting or a bonus system—there's a watch in this illustration that exactly fits your needs.

For Locating Wastes
Computing Costs
Setting Rates for Piece Work
Establishing Bonus Plans

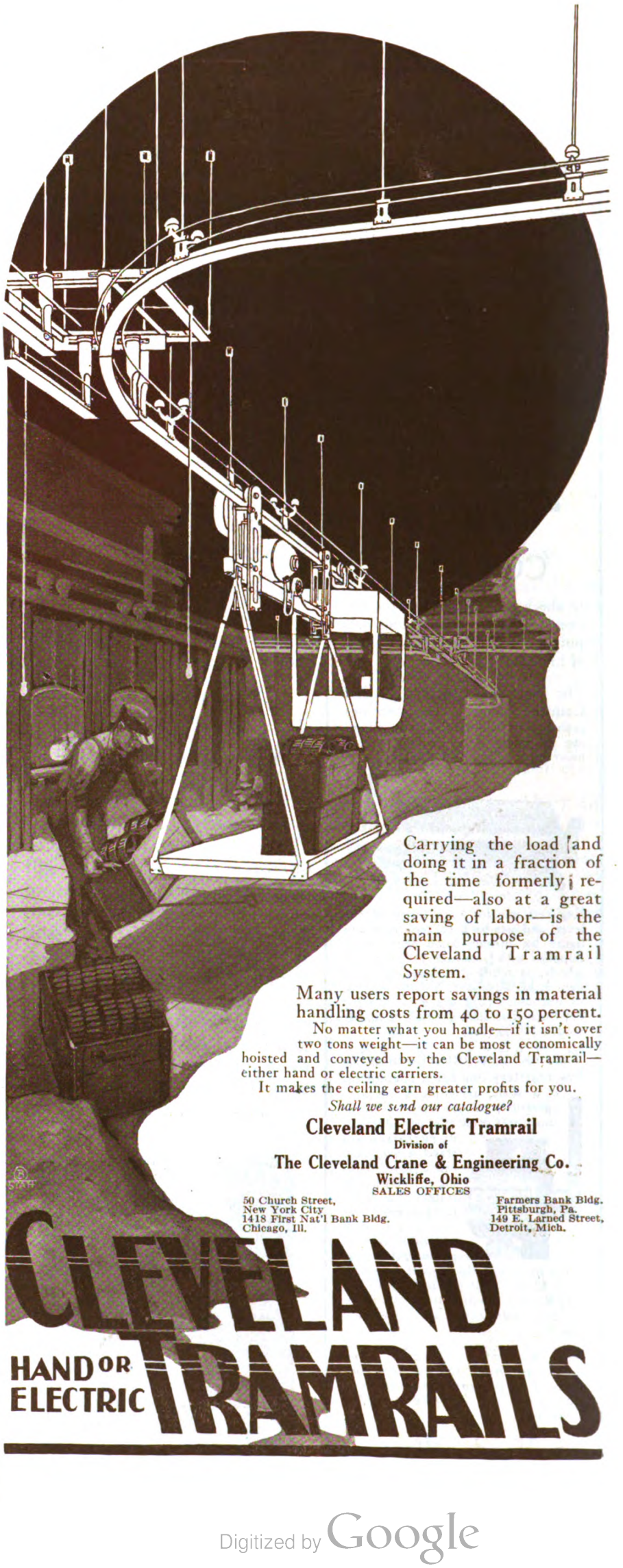
You can use any one of these watches for every kind of time study. But each has special features that facilitate certain types of work. No. 1 has a plain decimal dial with the "take out time" feature. No. 2 has, in addition, direct readings in production per hour up to 1 minute jobs. No. 3 carries the same readings up to 5 minute jobs, in seconds and half-seconds. No. 4 gives all readings in decimals and shows production figures up to 3 minute jobs with a special arrangement for timing jobs up to 30 minutes. No. 5 is the "split hand" watch with the "take out time" improvement which now permits careful studies of multiple operations and parts of operations. Each watch has this "take out time" feature.

Any Watch Sent on Approval to Responsible Concerns

Pick the watch that fits your job. We will gladly send it with a descriptive pamphlet on its use to any responsible concern on approval. Put it to any test you wish—prove its advantages in facilitating the work and guaranteeing absolute accuracy. Each watch is backed by our unlimited guarantee. Write us today for the instrument that fits your requirements—or in case you desire our advice, tell us the class of work you are doing and we will ship you the watch to meet your needs. No obligation. Write today for detailed pamphlets, or for pamphlet entitled "More Jobs for the Factory Stop Watch."

MORTIMER J. SILBERBERG CO.

Peoples Gas Bldg. Pioneers in Manufacture and Sale of Time Study Watches **Chicago, Illinois**



Carrying the load and doing it in a fraction of the time formerly required—also at a great saving of labor—is the main purpose of the Cleveland Tramrail System.

Many users report savings in material handling costs from 40 to 150 percent.

No matter what you handle—if it isn't over two tons weight—it can be most economically hoisted and conveyed by the Cleveland Tramrail—either hand or electric carriers.

It makes the ceiling earn greater profits for you.

Shall we send our catalogue?

Cleveland Electric Tramrail

Division of

The Cleveland Crane & Engineering Co.

Wickliffe, Ohio

SALES OFFICES

50 Church Street, New York City
1418 First Nat'l Bank Bldg. Chicago, Ill.
Farmers Bank Bldg. Pittsburgh, Pa.
149 E. Larned Street, Detroit, Mich.

CLEVELAND HAND OR ELECTRIC TRAMRAILS

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Underlying All Wage Systems

Whatever you base wages on, you mean fundamentally to pay on a merit basis; a *production* basis. The problem is, how best to appraise your worker.

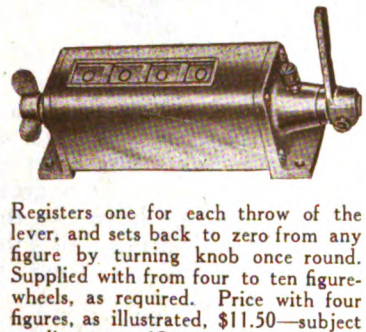
Veeder Counters give you, automatically, the most accurate measure of an operative's value that can be had—just as they give you the most accurate measure of the product of any particular machine.

From the heaviest punch press to the nimblest wrapping machine there is a suitable

Veeder COUNTER

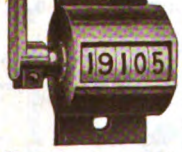
to check up the worker's production, make him look to his output and make sure he's worthy of his wage.

The Set-Back Rotary Ratchet Counter below is for machines such as punch presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-Back *Revolution* Counter of similar model, $10.00 (list).

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines, and most adaptable for experimental work. If run backward, the counter subtracts. Price $2.00. (*Cut ⅜ size.*) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.



You can get a "Veeder" for every machine where the pay should be proportioned to production; ask for the counter booklet.

The Veeder Mfg. Co.,
63 Sargeant St., Hartford, Conn.

(*Continued from Page 60*)

up to the largest timepiece. The manufacture of the crystals was simply for personal use, at first, but today several large concerns are buying U. S. made crystals for their high grade watches. The jobbing trade, however, is mostly handling the imported goods. The American concern is in a position to meet the demands of this latter market and is gradually extending operations. About five hundred hands are employed at present. This represents skilled help, fully trained for the work.

Regardless of the adeptness of the Japanese, and the renewal of large foreign imports, the work in the American watch crystal plant is being systematized and adapted to machine production. Every machine in the plant is an outgrowth of the experience and ideas of the executive staff. They are designed and manufactured at the Company's machine shops. They are models of simplicity, efficiency, and accuracy. They represent the reward of faith and perseverance over "It can't be done."

"WE are much in the habit of pointing with pride to our trade balances and factory output and crop reports, in evidence that all is well. It may be. Whether our prosperity is real and will last is all a question of what we are making of it in human welfare and power of self-control. It will not last if we do not distribute it fairly; it will not last if we merely spend our unaccustomed wealth in cheap indulgence and have not the power to assimilate it in wholesome growth."—Hayes Robbins, in *The Making of Tomorrow.*





What Secrets Do the Walls Conceal?

FORESIGHTED builders and investors are frequently more concerned about the things they cannot see about a building than in its outward appearance. One of their greatest concerns is the condition of the extensive arterial systems buried in walls and floors. If the pipe is Byers, they have the utmost assurance against future heavy repair expense, including extensive damage to walls, floors, rugs and furnishings.

Byers pipe is made of genuine old fashioned wrought iron, which is the only welded pipe whose dependability has been proved by past performance covering a period of over 6 years. It is made by the century old hand puddling process, which gives to the metal a life far beyond that obtained from products of modern processes.

The diagram shows the average extra cost of Byers pipe in a pipe system to be about 7%. As against this small amount the cost of replacements, if they became necessary, would be so heavy as to jeopardize the very investment value of the building.

In dwellings and skyscrapers, Byers pipe is the choice of all those who *know* materials. Ask your architect, engineer or contractor.

Byers Bulletin No. 38 "The Installation Cost of Pipe" sent free on request.

A. M. BYERS COMPANY, PITTSBURGH, PA.
Established 1864
New York Philadelphia Boston Chicago Cleveland Houston

BYERS PIPE

GENUINE WROUGHT IRON

Look for the Name and Year rolled in every length

Digitized by Google

Engineer Shoemaker of Western Plant Discovers Way to Cut COAL BILL in HALF!

Modern equipment—assumed full efficiency—yet the Hays Home Study Course in Combustion showed him how to save 113 tons of coal a month with an even bigger load. Will you give your Engineer this training in exchange for a similar saving?



May.....213 Tons
June.....139 "
July.....131 "
Aug.....100 "
BIGGER LOAD

DO you want to make such a saving in your plant? In the face of rising coal prices and a desperate shortage of fuel, will you consider a business like plan for cutting your coal bills? This is my suggestion.

The plant in question had every type of modern appliance and mechanical device for burning coal efficiently. Yet a new man comes in and saves 113 tons of coal a month—cuts the coal bill in half! Why? Because charts, gauges, automatic stokers, blowers and draft regulators cannot run a boiler room without the directing genius of mind that knows what every sign means, what to do in every case. Engineer Shoemaker was trained by the Hays School of Combustion. He had a fundamental and thorough knowledge of every phase of combustion, he knew how to inspire the men to more interest in their work and he knew *every short cut to more power for less money.*

500 lbs. From Every Ton is WASTED!

With all the modern appliances for saving fuel the average plant today is wasting 25% of every ton of coal. In short, you are paying the full ton price for only 1500 pounds of fuel.

Now, a question. If a man came to you and said, "Do thus and so and you will save $500.00 every month that your plant runs," and you investigated and found that he was right, would you be willing to pay him for his definite information? I think you would. You would be foolish if you didn't for every cent saved on fuel is clear profit-velvet.

How You Can Cut This Waste

Then, here is my plan. Will you allow me to take one man from your plant—the Chief Engineer, the Superintendent, or an apt fireman—and, without taking a minute of his time from the job, give him the training in his spare time at home that will enable him to make for you a saving similar to or even greater than that made by Shoemaker for his Plant? And will you pay for his training—less than a hundred dollars—with the understanding between you and me that, after he has finished the course, if you are not satisfied that this small investment will be repaid many times in actual profits, that I refund the money?

More Vital Than Money

This is not merely a question of saving coal when it is at its peak in price. It is more far-reaching than that. The coal shortage is so acute that hundreds of plants have been forced to shut down. Hundreds more have been cut to half time. The really vital question is "Will I be able to get enough coal at any price to keep my plant running?"

If the man you pick to have us train could—not cut bills in half—but just get the efficiency from that wasted 500 pounds—even then, you would be getting the power equivalent of 1½ tons from every ton you bought.

Is it worth trying? My offer is bona fide. I will train your man at my risk. Or, *I will train all your men.*

If Engineer Shoemaker were the only graduate Combustion Engineer who had made a saving like this for his company I could not make such an offer. What he has done is only a drop in the bucket. Read the records shown in the panel to the left.

Other Big Savings

Saves $540.00 a Month

"Without scales, feed meters or draft gauges to work with I have cut coal consumption from 15 tons a day to 9.2 tons, saving $540.00 a month." K. R. Williams of Charleroi, Pa.

Savings Quickly Noted

"Already I have made a saving recognized by more remuneration." F. E. Burgess of Philadelphia.

Fuel Efficiency Wins Recognition

"Have had two raises as a result of the saving I have effected since taking the Hays Course." Gordon Kelly, Cambridge, Mass.

$200.00 Saved Here

"In the last two months I have saved $200.00. At least 50% of this was in coal saved." William Weston, another student.

Cut Coal Bill 15%

"I have cut our coal bill 15%." Edw. C. Grove.

Saved 60 Tons in One Month

"Saved 60 tons of coal this September compared with same month last year." George W. Austin, Tuskagee, Ala.

Reduced Consumption 10%

"Have reduced fuel consumption 10%." L. B. Quam, of the Oil Belt Power Company.

FREE *Where Shall We Mail Your Copy of This Cost Cutting Book?*

The records shown are not remarkable when you consider the records of the men who prepared this course. Those whose experience is combined in this training are: Jos. W. Hays, well-known writer and consulting engineer; Prof S. W. Parr, of the University of Illinois,—authority on fuel chemistry; Fred R. Low, Editor of "Power"; David Moffat Myers, prominent consulting engineer and formerly of the Fuel Administration; Arthur L. Rice, Editor of "Power Plant Engineering"; W. L. Abbott, Commonwealth Edison Co., Chicago; I. E. Moultrop, Edison Elec. Illum. Co., Boston; and Jos. Harrington, stoker expert.

Any Man Can Learn How

This course in Combustion and Fuel Efficiency is so interesting, so clearly written that any man of ordinary intelligence—with no better than a common school education—can master it and become as good and as expert a Combustion Engineer as though he had spent four years at a technical school. From the very first lesson he learns principles and what is more important, how to apply them at once, in his daily work. This is true throughout the course.

Send Coupon Now

But what you are interested in is "How much fuel can I save?" Space forbids details. We have prepared a book which will give you the whole story, tell you all about the course and about the various plans now in use in America's leading plants for training the men to stop the hundreds of little leaks that waste coal. Paste the request printed below to your letterhead and mail it at once. The book will be sent free without cost or obligation.

HAYS SCHOOL OF COMBUSTION, Dept. 77
1412-14 S. Michigan Ave., Chicago, Ill.

Hays School of Combustion, Dept. 77
1412-14 S. Michigan Ave.,
Chicago, Illinois.

Send me your Book on Combustion without obligation.

Name.....

Address.....

City.....State.....

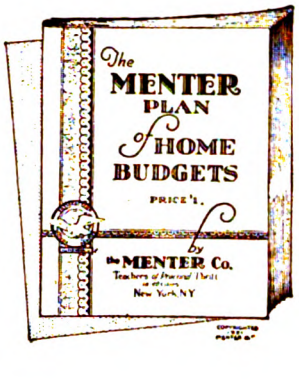
Company.....

Position.....

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First Aid to Avoiding the Friction Due to Cutting Wages

Get This



(post paid on request on your letter-head)

These plan books come in 100 lots and they are sold to employers of Labor at 25c each, any excess over cost is applied to advertising. These books are retailed at $1.00 each to individuals in retail stores, book stores, drug stores, department store book departments.

WHEN INcome is reduced—the problem of living within it is increased—Advice from the employers who have cut the income IS never thought much of by the employee.

BUT—a practical plan showing HOW to budget that reduced income—a plan based upon ACTUAL and Liveable conditions—showing how to apply "Practical Thrift" to Living and Saving—to control OUTgo and INcome, the HOW is always gratefully studied—That's what we have worked out—NOT merely a book—NOT an accountancy system—but a PLAN of Home Budgets—Direct—USABLE.

Here it is, look it over.

It's endorsed by leading Bankers—Economists and business men everywhere.

Tell us how many you care to have to give or sell to your employees.

The cost to you will be nominal. It will cover our actual cost of production and compilation and every dollar over goes into further advertising IN YOUR LOCALITY OF THIS PRACTICAL THRIFT IDEA.

Help your employees, indirectly by showing them HOW to have and SAVE and still enjoy the little things that make life more than mere existence.

Get this First Aid to thrift—this Silent Partner of the individual. Write us a frank constructive criticism and say whether you care to help along this practical way to avoid discontent due to reduced incomes among the wage earners.

The man who plans or budgets his income so that he saves something out of what he makes is a more valuable employee than the spend-thrift.

This campaign helps to make ***better satisfied*** employees through practical education.

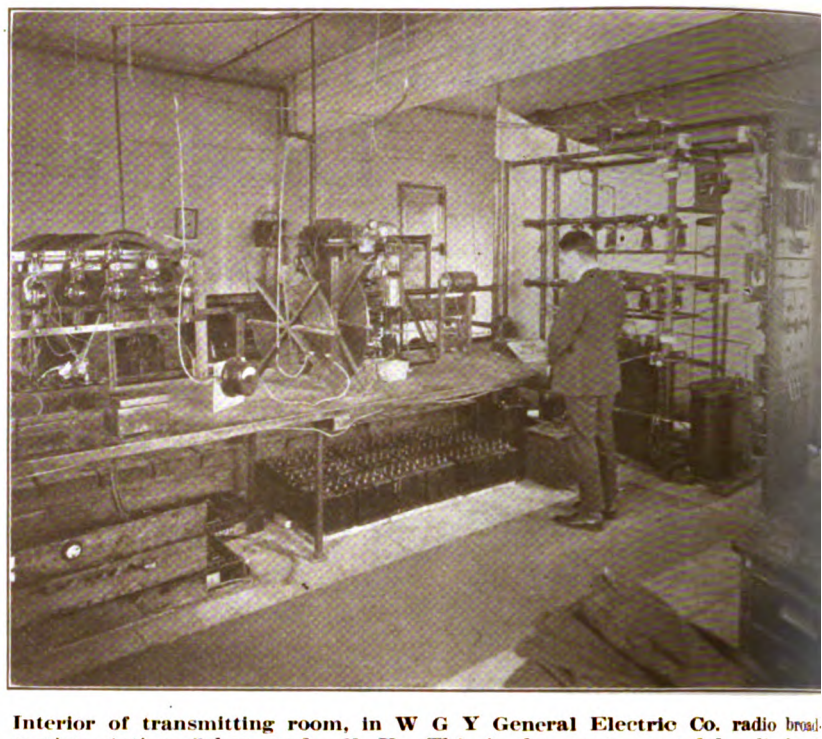
MENTER

Teachers of THRIFT Since 1889.

"Thrift Division"

Suite 2, 1419 Seventh Ave., New York, N. Y.

While others TALK thrift—you can show your employees "HOW to be thrifty."



Interior of transmitting room, in W G Y General Electric Co. radio broadcasting station, Schenectady, N. Y. This is the most powerful radio broadcasting station in the country. On one occasion messages were picked up in Cuba 1,450 miles away. Picture shows tube sets, control board and other apparatus. The programs are sent out from another building nearby.

Developments in Our Newest Industry

AS we go to press, comes the announcement that the World Series games, at the Polo Grounds, New York, are to be "broadcasted," play by play, to palpitating thousands of fans. To the radio enthusiast, who has kept in touch with developments, this news is less startling that it is to those who mistook the summertime lull for an evidence of collapse in the whole radio industry.

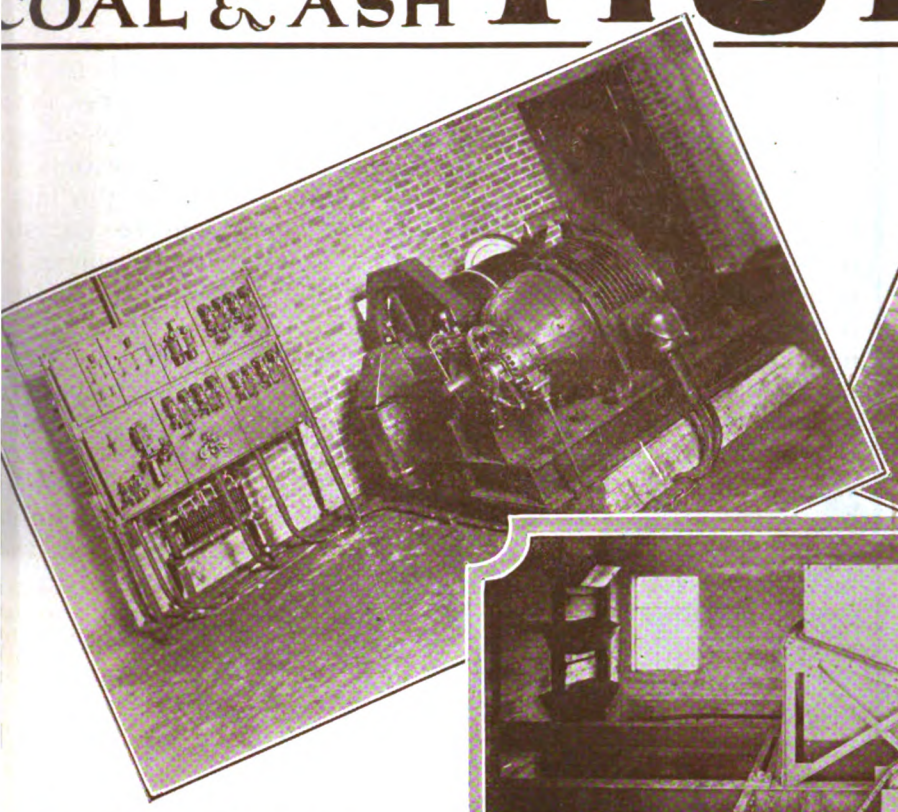
The chief unconquered enemy of radio is the existence of "static"—stray currents in the ether or in the earth's atmosphere, which create such a medley of sounds in the receiving apparatus as to drown out everything else. Just as summertime is the worst time for thunder showers, so it is the worst time for "static"—and therefore the least favorable time for radio broadcasting. When we review the strides made in the past few years, it is not unlikely that even "static" will be conquered before long; so that this newest art and science and industry may take the permanent place its importance warrants, without seasonal interruption.



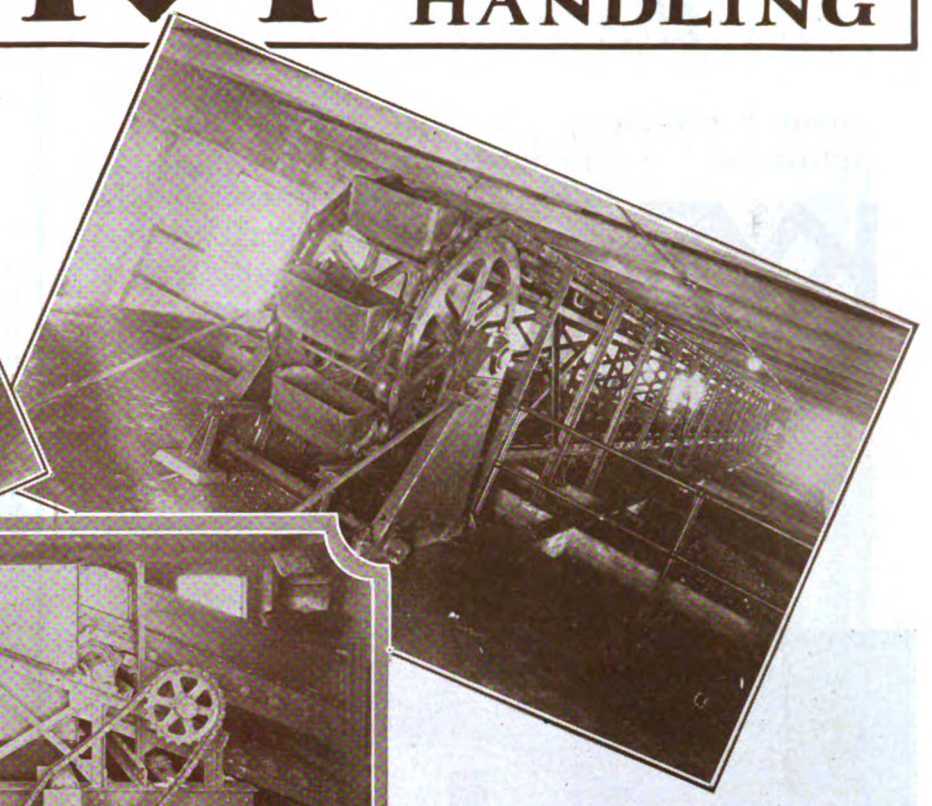
Assembling amateur wireless receiving sets for shipment in one of the factories of the General Electric Company. Operators are hard put to it to meet the tremendous demand which has grown up almost over night.

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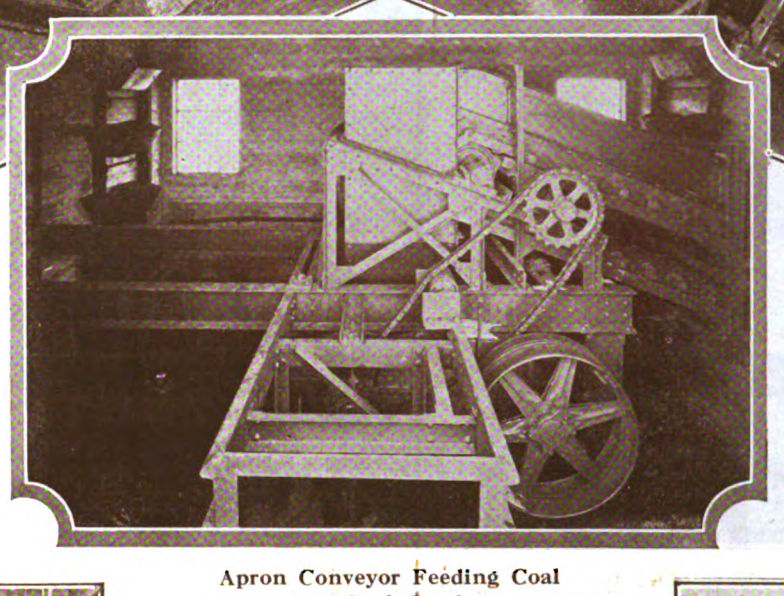
COAL & ASH HUNT HANDLING



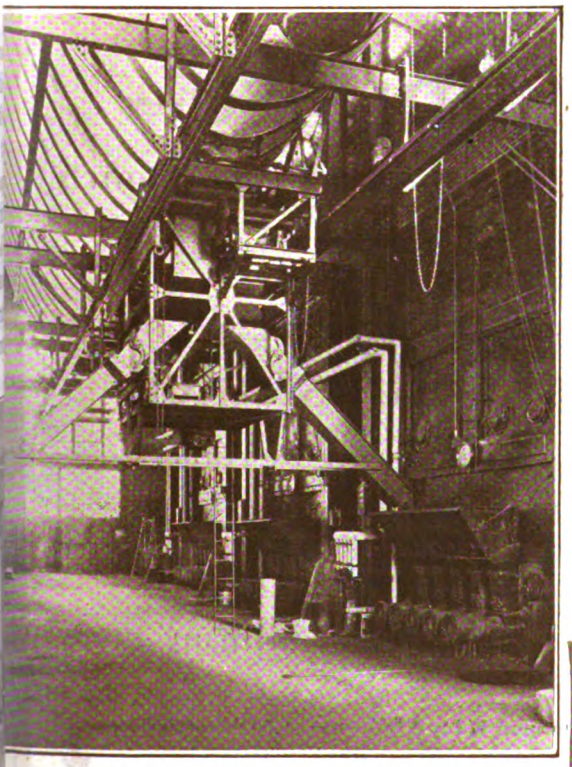
Control Panel and Hoisting Machinery for Skip Hoist



Double Run of Conveyor over Coal Bunker



Apron Conveyor Feeding Coal into Coal Cracker



Electrically Operated Traveling Weigh Larry

Cutting Down Power Costs

EVERY item of labor involved in getting coal from the cars to your grates, and in removing the ashes after combustion, is just that much added to your power costs.

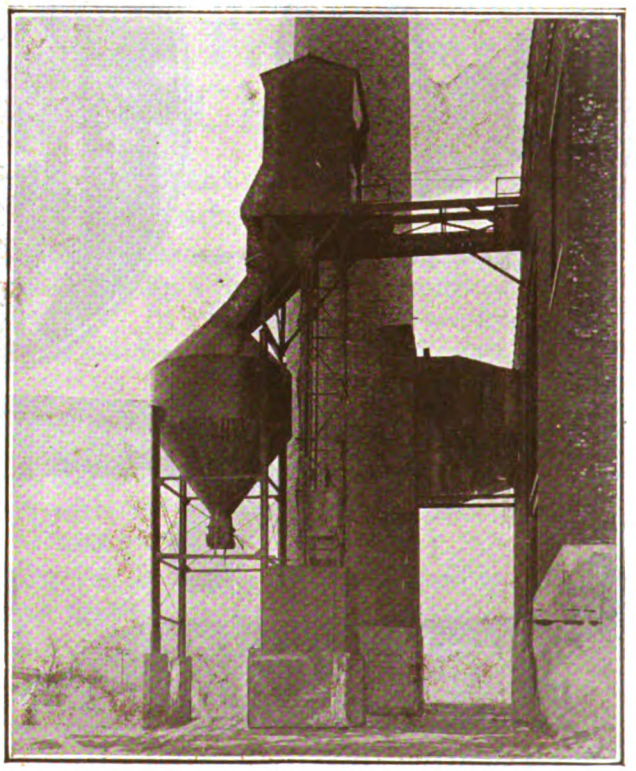
The photographs grouped on this page show a complete coal and ash handling equipment which we recently installed at the Utica State Hospital.

The installation shown effects a great saving in the handling of coal and ashes.

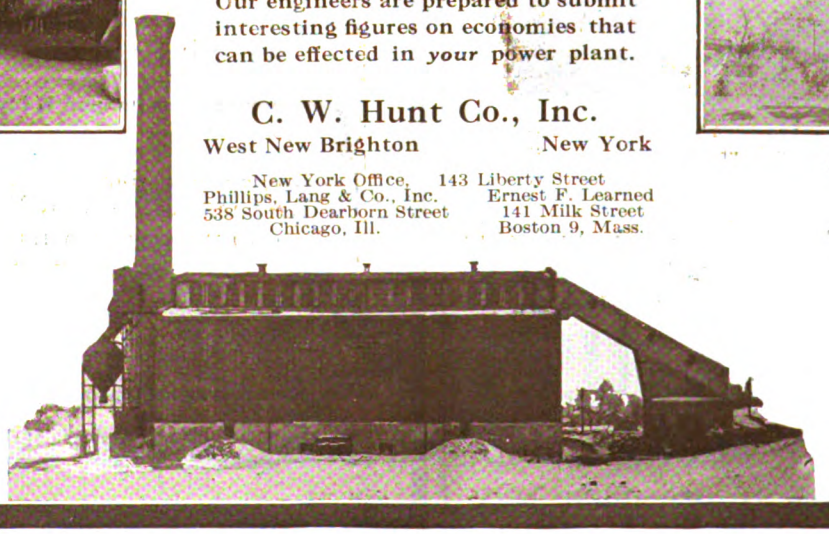
Our engineers are prepared to submit interesting figures on economies that can be effected in *your* power plant.

C. W. Hunt Co., Inc.
West New Brighton New York

New York Office, 143 Liberty Street
Phillips, Lang & Co., Inc. Ernest F. Learned
538 South Dearborn Street 141 Milk Street
Chicago, Ill. Boston 9, Mass.



Skip Hoist Handling Ashes to Storage Tank

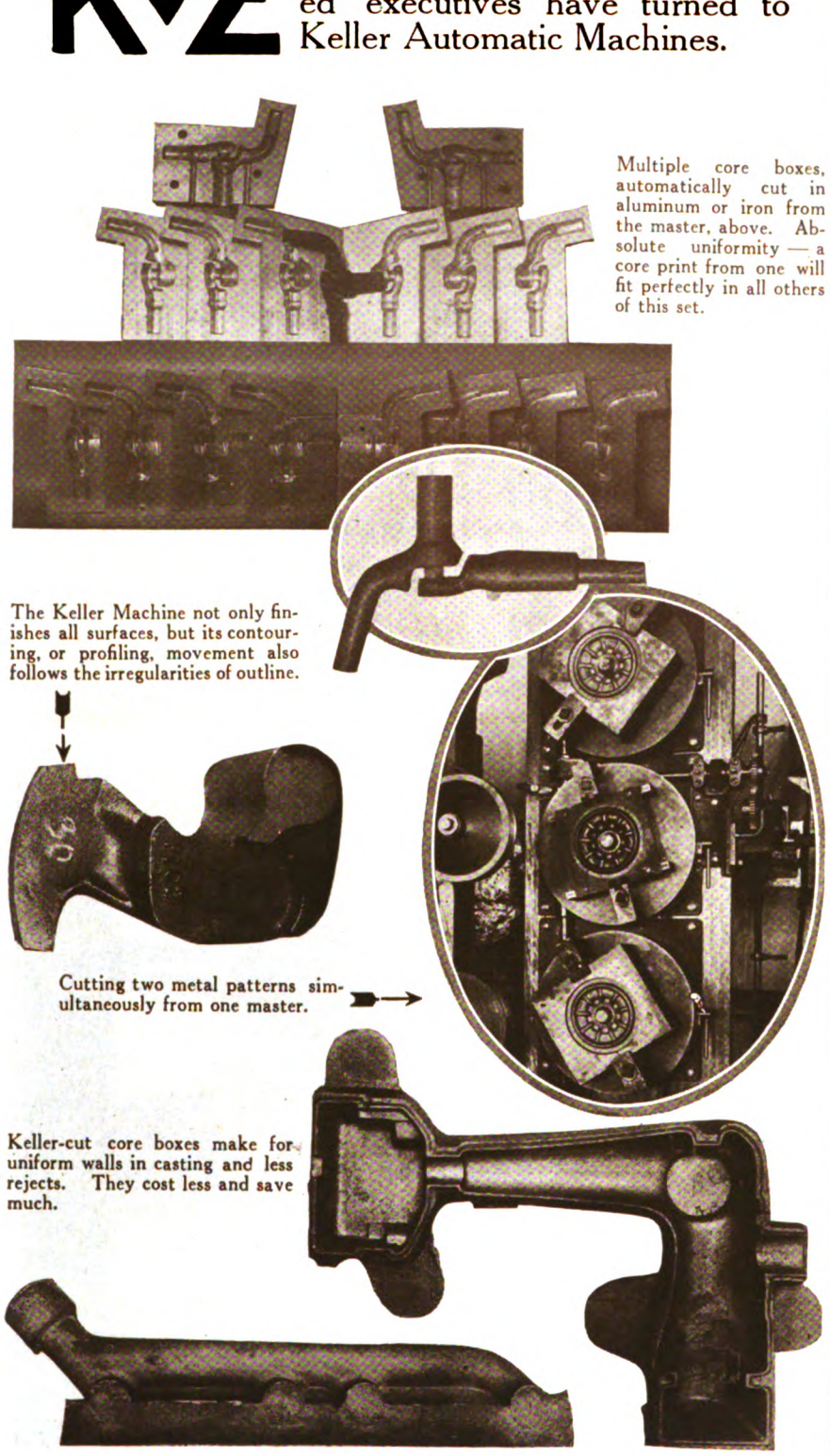


General View of Utica State Hospital Power plant

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Do It Mechanically —by the Keller Method

Quantity production *in the foundry* calls for uniform and accurate metal core boxes and patterns. To secure these quickly and at lower costs, keen visioned executives have turned to Keller Automatic Machines.



Multiple core boxes, automatically cut in aluminum or iron from the master, above. Absolute uniformity — a core print from one will fit perfectly in all others of this set.

The Keller Machine not only finishes all surfaces, but its contouring, or profiling, movement also follows the irregularities of outline.

Cutting two metal patterns simultaneously from one master.

Keller-cut core boxes make for uniform walls in casting and less rejects. They cost less and save much.

Metal pattern for an exhaust manifold, a typical job. There is no limit to size, depth or intricacy—anything from valve fittings to bathtubs.

Keller Machines reproduce direct from plaster, wood or metal masters—the Keller method is applicable to every industry using Dies, Molds, Metal Core Boxes or Patterns.

Ask How It Applies to You

KELLER MECHANICAL ENGRAVING CO., 58 Washington St., Brooklyn, N. Y.

What Suggestion Systems Have Accomplished

(*Continued from page 15*)

tion is needed at first to get the workers to understand that a mere complaint is not a suggestion, and to make them catch on to what is wanted; but when this is accomplished there will come real suggestions, many of them minor and intrinsically insignificant, but important and significant for the attitude of mind which they reveal. Only occasionally will a big idea come through the suggestion mill; but the savings wrought by this occasional big improvement plus the total of the little savings effected by numerous minor suggestions mean in the long run a big, tangible money value to the plant. The head of an important silk manufacturing company said recently that his concern saved more than $100,000 last year through improvements resulting from employee suggestions.

In the average factory where a suggestion system is working effectively, there will be offered in the course of a normal year suggestions affecting practically every department and feature of the business. There will be suggestions for the improvement of the product, for the better merchandising of the product, for improving personnel relations within the organization, for bettering working conditions, for increasing co-operation, for reducing spoilage and waste, for improving the equipment, and for improving the working methods. No statistics have been compiled on the subject, but, in the opinion of a number of suggestion department managers, the bulk of acceptable suggestions offered by factory workers affect (1) the product, (2) the equipment, (3) the working methods.

And of the three named above perhaps the greatest

(*Continued on Page 68*)

Just Suppose--

You had coming to you every month

A big bunch of Pictured Progress

Such as you see in this copy of

Industry Illustrated

Wouldn't you give it a hearty welcome?

Wouldn't it put a dash and a sparkle into the daily grind you have always wanted—but which you have found hard to get?

And *wouldn't* it be worth to you many times what it costs?

This coupon is for YOU—use it NOW

Engineering Magazine Co.
120 West 32nd Street, New York

SEND ME INDUSTRY ILLUSTRATED every month for a year. I shall remit when your bill comes—sometime within the next thirty days.

Name.....

Mailing Address.....

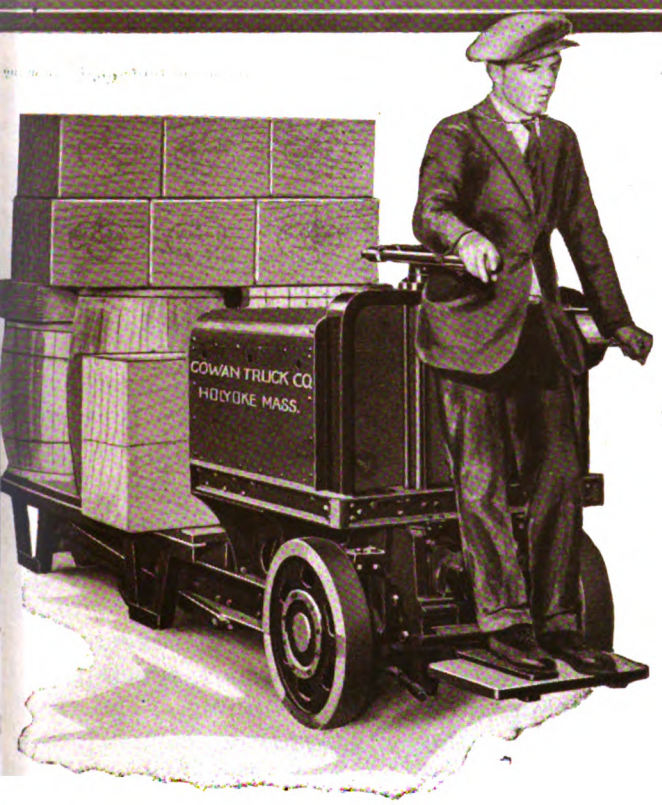
Company..... Position.....
(Important confidential information—for our own records only)

ANNUAL SUBSCRIPTION $1 In Canada, $1.25; Foreign, $1.50

10-22

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Cowan Electric Truck Saves At Brown-Lipe-Chapin Co.

Mr. E. W. Zimmerman, Plant Engineer of this Company, at Syracuse, N. Y., advises:

"The actual saving effected by the truck is best figured roughly by estimating its saving of one man's time, which would probably amount to $1200 per year. In addition to this, we find a great saving which cannot be estimated in dollars and cents, in the quicker delivery of materials to the various departments, but this is a very noticeable feature with the truck."

Cowan Electric Lift Trucks, one-man operated, automatically pick up and deposit skidded loads weighing thousands of pounds. They eliminate rehandling with its great waste in time and labor and speed delivery of materials.

We have actual facts and figures on the worth while savings of Cowan Electrics. A Cowan representative will gladly lay them before you. Shall we mail you a copy of Bulletin No. 5?

Cowan Truck Company, 6 Water Street, Holyoke, Mass.

N. Y. Office: Grand Central Palace. Offices in Principal Cities.

2057-N

COWAN INDUSTRIAL TRUCKS-TRACTORS

Originators *of the* "through ticket" *system for* moving loads

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CONVEYING



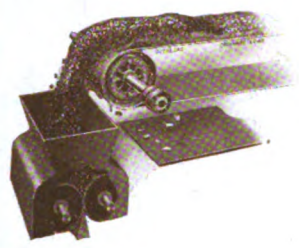
ELECTRIC TRACTORS

Transport Tons

where hand trucks move pounds. They reduce expense in all your departments.

Request Catalog 1208.

The Elwell-Parker Electric Company
Cleveland, Ohio



"High Duty" Magnetic Pulleys

For removing iron and steel from conveyed materials. Will positively protect your crusher, grinder or pulverizer against injury from "tramp iron."

Magnetic Mfg. Co.
267-275 23rd Ave, Milwaukee, Wis.

POWELL Pressed Steel Platforms

FOR USE WITH ALL HAND AND ELECTRIC LIFT TRUCKS



POWELL Platforms are cold-pressed from a **single piece of steel** and will stand up under a lifetime of hard usage! They combine lightness, ruggedness and extreme durability. Standard or special sizes furnished promptly. Get our literature and low prices.

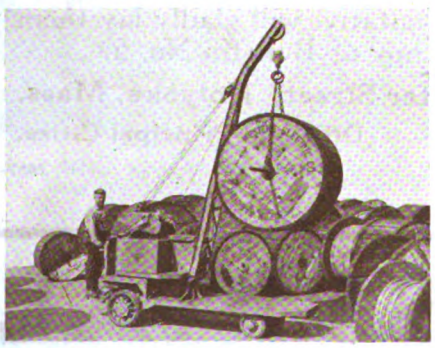
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HANDLING

(Continued from Page 66)

number of suggestions received relate to equipment and to methods. What they work with and how they work are the two subjects of most intimate proximity and greatest importance to the average factory operatives; and naturally when they begin to think of possible improvements, they think of the tools or machines with which they work an of the methods of working.

Very often, when a suggestion involves the improvement of a tool or machine or perhaps the introduction of an entirely new piece of equipment, the change also affects the method of working. Such a suggestion is the following, taken from the experience of the Eastman Kodak Company.

Certain assembling operations in the shutter department of the camera works involve the handling of tiny screws with a magnetized screwdriver. But in picking up the screws it was rare that the screwdriver got them on the heads. Usually the worker had to take each screw off and carefully place it with the end of the screwdriver in the slotted head; then it was easy to insert the screw in its proper place in the shutter and drive it in. Pieceworkers in that department had been doing the job this way for many years, when one day the idea of using a positioner occurred to one of them. She suggested that a metal saucer be provided, in the bottom of which some countersunk holes had been drilled, and that the screws first be placed in this saucer. A gentle tapping of the saucer would cause the screws to drop into the holes, heads up, in position for picking up with the screwdriver in the slot. By the use of the positioner the hand operation was eliminated entirely. A motion study showed that the new method saved one and one-half seconds per screw handled, and if applied to all similar operations in the works it means a yearly saving of 4,670 hours.

Sometimes a suggestion means simply an improvement in the equipment. An example of this is furnished in the oil-burning furnaces used in the heat-treating department of the National Cash Register Company. When it became necessary to change from gas to oil as a fuel, a burner was on the market was bo and installed. It did not satisfaction, and as a resu new type of burner was ceived in the department suggested to the manage Today practically all of the burning furnaces, both large furnaces in the h treating department and smaller ones used in vari departments, are equip with the new burners, w are made in the plumbing partment at a cost that is atively trifling.

In this same factory i necessary to go over the l ing system from time to ti and the job of getting at r ators for repairing was troublesome one. Four were usually required to do lifting, and besides there preliminary work in clear away space, and the interr tion of other work while the pairing was in progress. of the employees suggeste rig and tackle for lifting radiators, and since this s gestion was adopted the w is easily done by one man wi out disturbing the machine workbenches, or workmen.

Another improved met installed in the factory of National Cash Register C pany as a result of a sugg tion is the handling of a c tain kind of register k These keys are shot out o polishing machine through trough into a box. Under old method they piled into box helter skelter, frequen the box would overflow, a part of a man's time was quired to straighten out keys and rearrange them efficient handling. In the n method, when a box is pla under the trough, a metal c which is divided into th narrow compartments, is p ed in the box, which it fits a loose lining. The effect the narrow compartments to cause the keys to straigh as they fall and lie para When the three compartme are filled, the metal case, wh has no bottom, is lifted out the keys lie in symetrical der closely packed in the

Sometimes the impro method suggested will aff the wiring of electricity or routing of material. An ployee of a city electric c pany in the West submitted his suggestion a wiring

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ram that eliminated a large umber of lights and meant ie saving of a considerable mount annually in both kilo-atts and equipment.

In a paper mill there was ironic congestion in the ship-ing room due to the blocking f the entrances with stock. ne of the men suggested the utting of doors through the alls of those parts of the mill djacent to the shipping room, nd when this was done there as a remarkable improve-ient. Instead of stock moving rcuitously, it now went by di-ect routes into the shipping oom, the blockade was relieved, and as a result the produc-on at one of the large paper achines increased 42 percent.

The suggestion of a foreman i another paper mill decreased the waste of paper rolls om the machines. Instead of sing a hook as was the cus-m, he suggested, using a nife, and the surplus paper, hich heretofore had been re-arded as so much jagged and umpled waste, was trimmed ito samples for the sales de-artment's use. The old meth-l had been to take samples om stock, and this feature the suggestion saved the mpany several hundred dol-rs annually.

Where a suggestion system functioning properly there ill crop up in the course of ie year a number of sugges-ons affecting the product. nce in a great while a sugges-on that means an outstand-g improvement in the article ay turn up, but it must be ad-itted that such suggestions re rare. Such improvements sually come from the engi-eers or designers or from me technical experts who re continually studying ways improve the product, simpli-y it, make it more efficient, ore economical, more service-ble, and so on.

Perhaps the greatest number f suggestions affecting the roduct that come from em-loyees are suggestions that ean a mechanical improve-ent in some detail. For ex-mple, the ribbon-reversing echanism on a cash register cludes a spring which is tretched between two arms. n earlier models the spring ould occasionally work off, eleasing the tension. To safe-uard against this one of the mployees suggested that the eyes at the ends of the spring be made oblong instead of round as theretofore. This little change in the shape of the eyes has entirely remedied the defect. The eye now can slip off the reversing arm only at one angle, and the tension of the spring prevents it from shifting around to that angle.

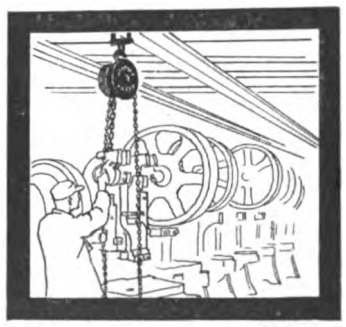
Another prize-winning suggestion in the National Cash Register Company resulted in making a certain part in two pieces instead of one. This part is the switch-lock lever. In the old-style one-piece lever, if repairs were necessary considerable taking apart was also required. In the new-style two-piece lever all that is necessary to remove the lever is to take out the two screws which hold together its two parts. The change seems small but it means an immense saving in time and labor.

In building the mechanism known technically as "telephone printer frames" it was usual to build them complete with ten teeth. One of the workmen discovered that the average system requires only four teeth, and suggested that the frames be finished hereafter with four teeth. The suggestion was adopted, frames built for stock are equipped with four teeth, and in those cases where more are needed it is easy to add teeth when installing the system. The result of this suggestion is not an improvement in the product, but a saving in labor and material and a decrease in the cost of production.

The suggestion system works with office workers quite as successfully as with factory workers. (It is generally thought best to have separate systems for these widely contrasting departments, though one office may handle both systems.) Economies in the office, as the management engineers have shown, are just as valuable and quite as important as economies in the shop. When the office employees are stimulated to offer suggestions, their ideas are generally concerned, in the main, with office methods, equipment, and clerical routine.

For example, a stenographer in the office of a Wisconsin factory sent in this suggestion which was favorably acted on by the management and re-

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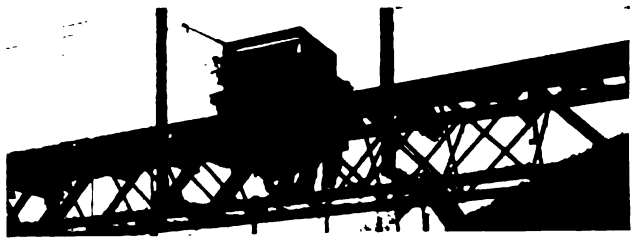
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In another factory office an employee suggested that a strict rule for filing material be adopted, which would rule out all matter that did not clearly promise to be of permanent value. As a result of his suggestion the files have been overhauled and relieved of nearly a ton of dead matter, and a system is now operative which will safeguard against such waste of filing effort and filing space in the future.

All of the results of suggestion systems mentioned in the foregoing are tangible. They mean improvements that you can touch or see. To a considerable extent in most cases they can be measured lars and cents basis. addition to these ma sults are intangible that are rightly reg many business executi important value in th

"We believe the val suggestion system to b limitless," said the ma a highly successful su department. "Our pla proved very profitable. It resulted in giving us an proved product, better facto and office systems, new selli and advertising methods, b ter health and safety feature has saved thousands of dolla in the cost of production, a in fact every phase of the co pany's business has been ben fited by the suggestion pla Another benefit that should n be lost sight of is the bene the suggestor receives besid the monetary prize, and that the increased knowledge of t business he gains by workin out his ideas."

From an executive in a other company, one in the f West, came this commen "The company is pleased wi the results of its suggesti campaign, and finds nothing the campaign that it wou change. The plan has prov to be an excellent stimulant department heads and to e ployees. It has been parti ularly valuable in elimina the excuse of the rank and f to sit around on a bench, t each other what they would if they were boss, and let it at that. With the suggesti system in operation, the m have a fine opportunity to t seven different officials (t suggestion committee) wh they think ought to be don with the possibility of gettin paid for doing it."

The intangible benefits a mainly three: (1) the cultiv tion of powers of observatio analysis, and judgment in t mind of the worker and of sense of working with t management for better pr duction, (2) the reflex influen on his daily work of a worker thinking constructively terms of improvement, an (3) the effect on a worker self-respect and attitude t ward his employer. These in tangibles do not lend them selves to any form of measure ment, but they may directl affect production, economie and profits.



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1 Because of its short wheel base, the "Whale" operates almost as easily on curves as on a straightaway. Tests have proved that a boy can operate the one-ton "Whale" even when it is loaded to capacity.

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4 Combination and radial thrust bearings are found only in the "Whale." The ball races are ground and the balls themselves are of high duty steel. This feature enables a one-ton load to be started by the pull of a man's little finger.

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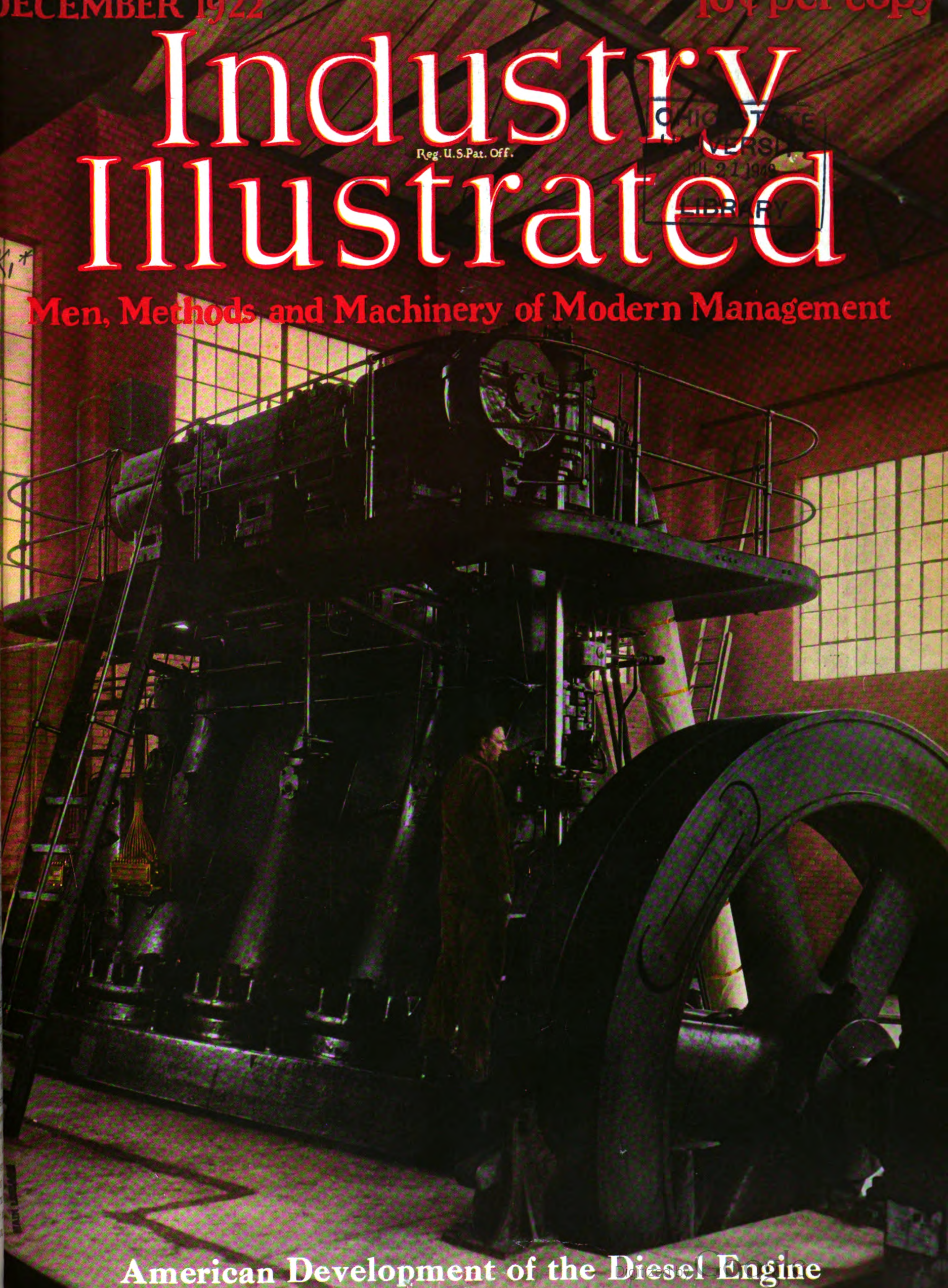
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Men, Methods and Machinery of Modern Management



American Development of the Diesel Engine

(See Page 8)



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BULLETIN 127

Industrial Bearings Division **New York, N. Y.**
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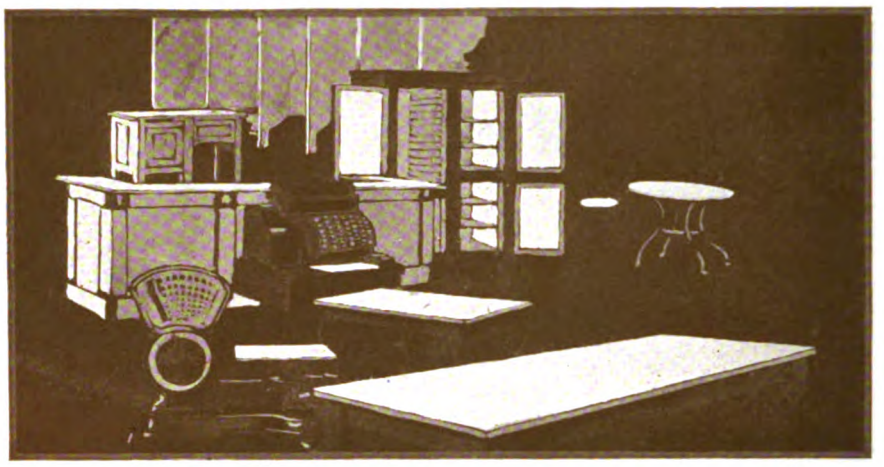
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To be a successful industrial manager you must be fully informed concerning all factors which affect the control and operation of men, methods, material and equipment. If you know only those things which are associated with equipment or materials, then you certainly cannot act correctly and decisively concerning problems of men or methods. You have to use snap judgment—in other words you *guess*.

Industry does not want any more guesswork. The millions of dollars of waste which have been the yearly record of industry must be saved. And it can be saved only by intelligent, competent management.

You can participate in this management only if you have accumulated a knowledge of successful methods which have been worked out by many industrial executives and engineers, in many plants, and in all branches of manufacturing.

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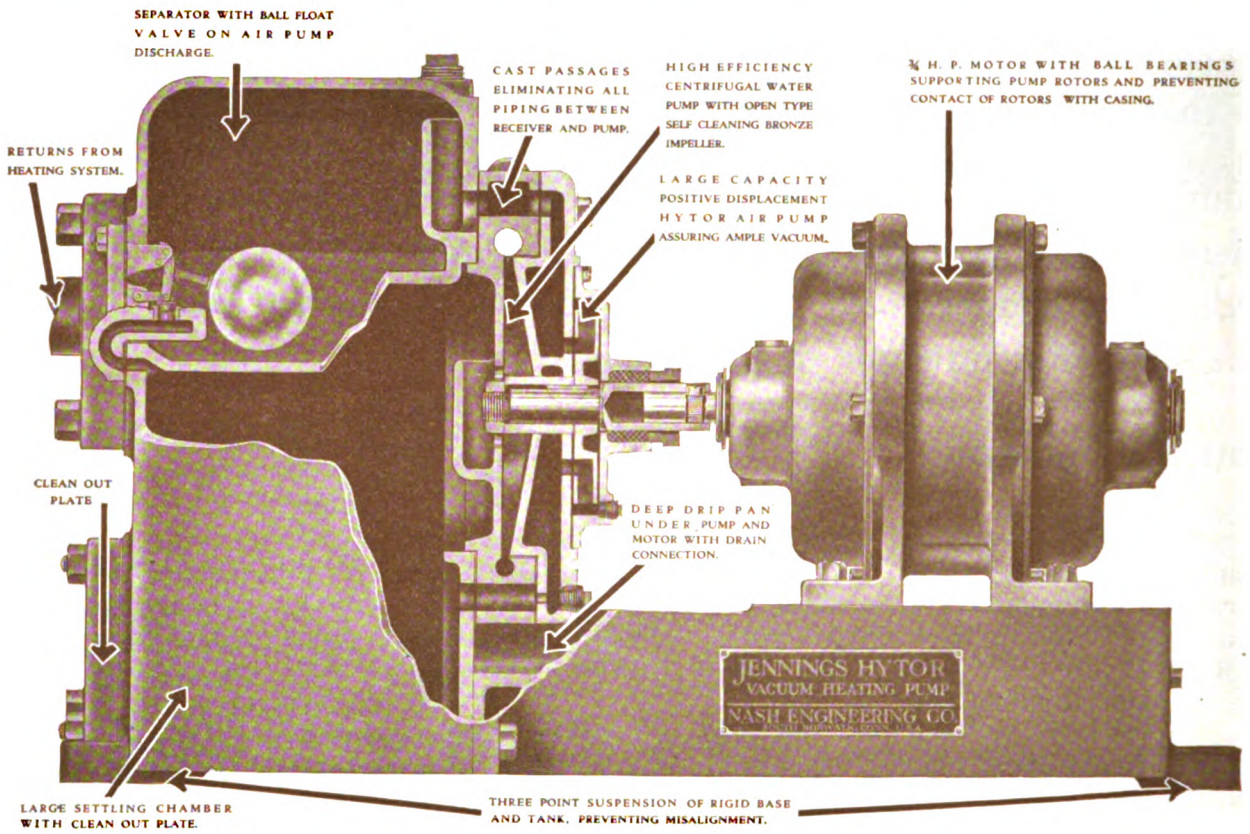
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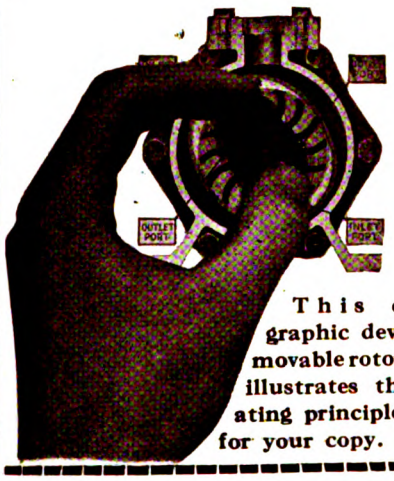
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Industry Illustrated

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EDITORIAL

Multiplying Manpower

LITTLE more than a century ago, man-power was the predominant source of energy. Man used the power of horses and oxen, and he utilized to some extent the power of streams and waterfalls; but in the aggregate, man's own energy output was the measure of the power available: if any industry employed fifty men, then that industry enjoyed the amount of energy those fifty men could exert, and no more.

Based upon exhaustive tests, it has been shown that the average energy output of the American workman in an eight-hour day is one-tenth of a horsepower. From census figures of the United States, we know that there are roughly forty million of our population, today, engaged in gainful occupations.

Even if we assumed that clerical workers could equal the energy output of manual laborers, this whole working population can produce but four million horsepower, available only one-third of each twenty-four hours. Suppose, then, we had no steam power, no electric power, no automobiles, no oil engines; suppose we had to use the methods of a century ago—let us take a concrete example:

In the past year, our railroads handled in round numbers four hundred billion ton-miles of freight, utilizing mechanical energy, and employing two million men. To handle that same amount of freight under the methods available a century ago, would have required the labor of *one-and-one-quarter billion men*—more than one hundred times our total population at that time—almost twelve times our total population today. Each of those two million railroad men, then, is accomplishing today by the aid of mechanical energy, as much as six hundred and fifty men were able to do a century ago. And, at the same time, the cost per ton-mile has dropped, from two dollars to about one-and-one-half cents.

Man's productive labor multiplied six hundred times, and the cost of that production reduced to a fraction of its former cost—and this in the short space of less than a full hundred years! And all through machinery, mechanical energy, *power.*

Iron and steel were produced a century ago, and with but little more than one-tenth horsepower per man employed; today, we develop forty-two horsepower for each employe—four hundred and twenty times as much. Flour mills have been grinding grain since the early days of history; today, every employe in such a mill has two hundred times his own energy-output to work with. And so for every industry.

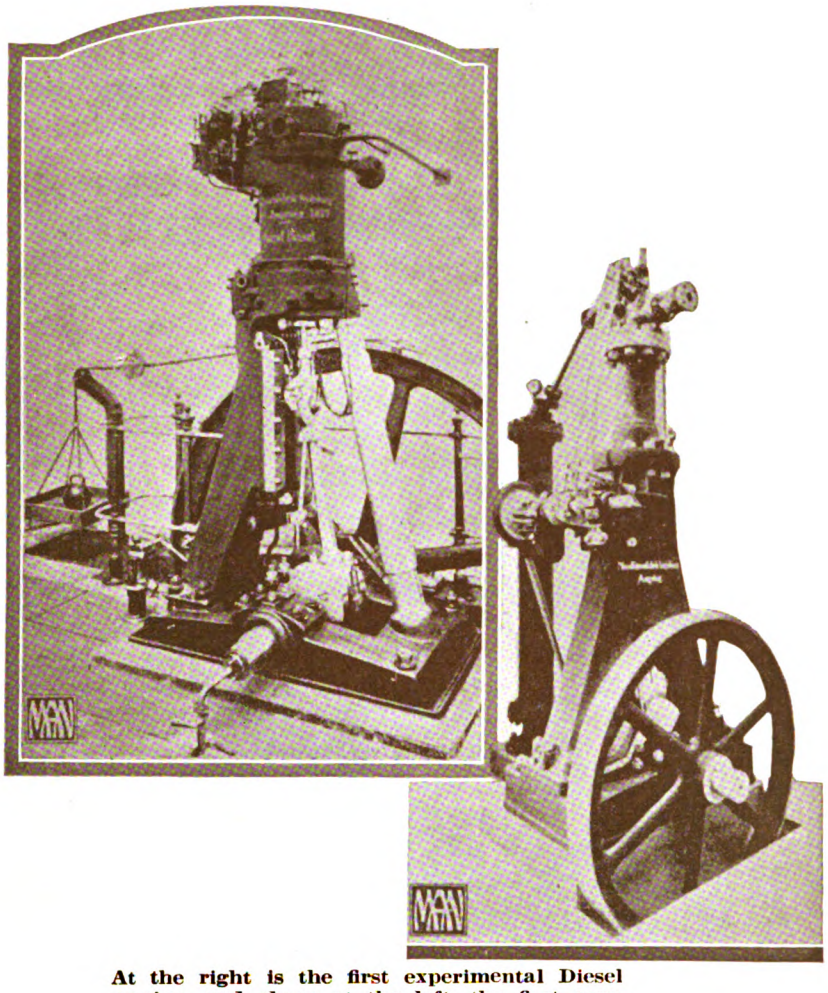
Wherever we turn, the keynote is power. More and more, "labor" is coming to mean attendance upon a machine which actually performs the labor. And the more cheaply we can produce power, the more far-reaching will be its benefits; for cheap power, in the final analysis, is the solution not only to industrial ills, but to the social and political ills of the world.

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American Developmen

How Ignorance and Prejudice are Being Conquer

By



At the right is the first experimental Diesel engine, and above at the left, the first commercial Diesel, of 25 H. P., built in 1897. (We are indebted to SPEED-UP for their courtesy in loaning us these illustrations; and to the Maschinenfabrik Augsburg-Nurnberg, Germany, who built these pioneer engines.)

AT the time of going to press, the latest available quotations for spot steam coal run from $2.50 to $6.50 per ton; the price of fuel oil, from 2¾ to 5 cents per gallon. Translating both of these into average cost per heat unit, we can buy roughly one million British thermal units in the form of coal for sixteen cents, or the same number of heat units in the form of oil for twenty-five cents.

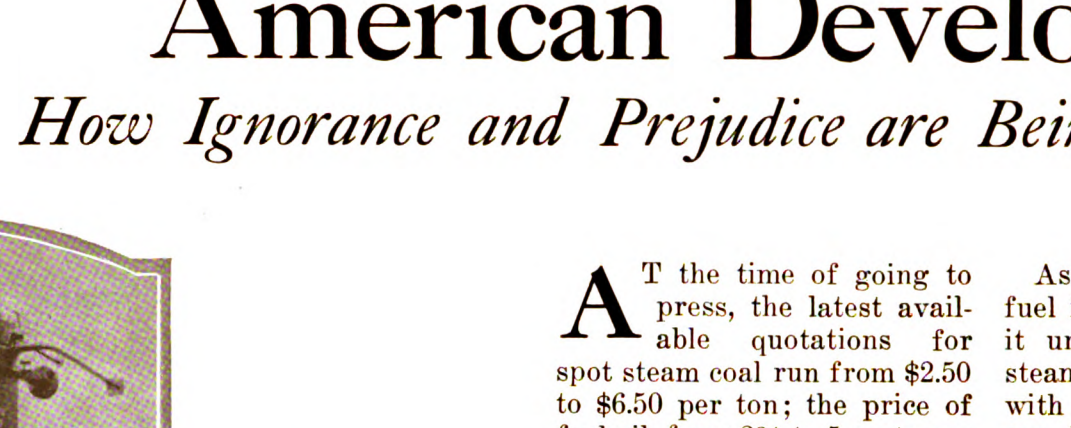
It may seem a far cry from the title of this article to an analysis of the cost of B. t. u.'s —but this article is intended especially for industrial executives and industrial power plant men; and the latter are interested in B. t. u. costs, while the former are beginning to sense the relation between these and their uncomfortably high power costs.

To repeat, then:—Today's dollar will buy an average of six and a quarter million B. t. u.'s if spent for coal, or four million B. t. u.'s if spent for oil.

Assuming that we buy fuel in the form of coal, it under boilers to gen steam, and drive an e with the steam, we can are blessed with a ne thousand-horsepower in installation) get some six per cent thermal effic from it. But if we ave the performance of indus power plants in this cou (which is not over 7 per *we actually are convertin than* 437,500 *of our origin and a quarter million heat into useful work.*

Suppose, on the other h we buy our fuel in the for oil, and burn it in a Diese gine. Then, although our lar buys only four million units, *we are getting* ov 200,000 *of these units in form of useful work.* In words, the Diesel engi within its limitations, t taken up in the course of discussion—furnishes p for approximately one- the fuel cost of an amount of steam power.

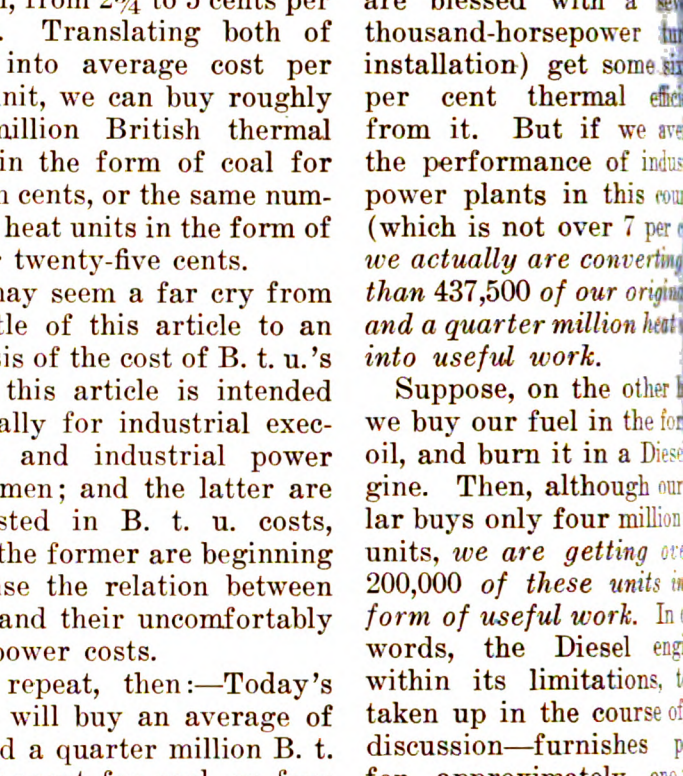
The gasolene carburetor, which can vaporize only gasolene or gasolene and kerosene mixed, is really a miniature gas machine. At the center is shown Doctor Diesel's original



design of a rotary f valve for powdered co while at the right is cross-section of a typi Diesel engine fuel valve essentially an atomizer.

AUTOMOBILE VS. DIESEL

At the left the events occurring in a gasolene engine cylinder just prior to the end of the compression stroke, and on the right the Diesel cylinder at same point in its cycle.



AUTOMOBILE VS. DIESEL.

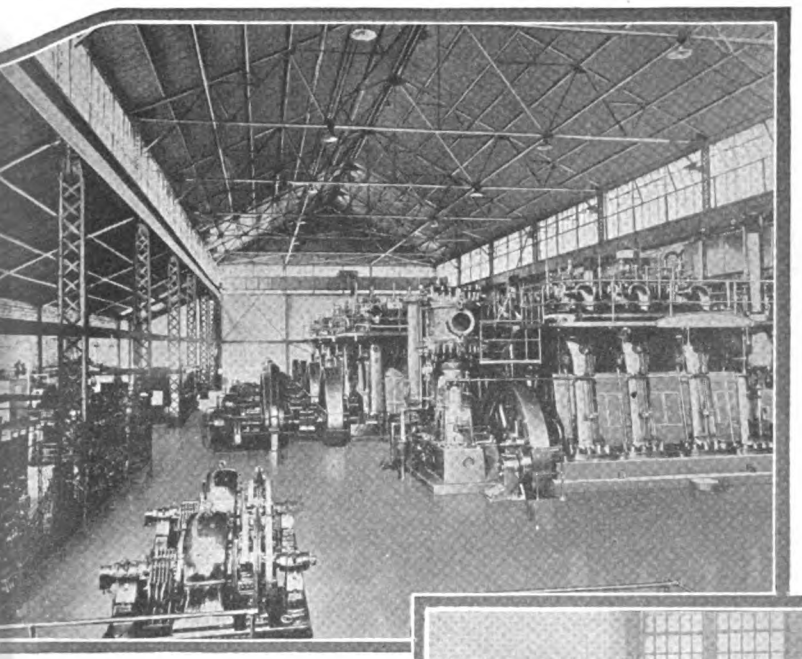
The contrast in the cycle of events between the well-known gasolene engine and the Diesel engine—the piston in each case having passed top dead center and begun the power stroke.

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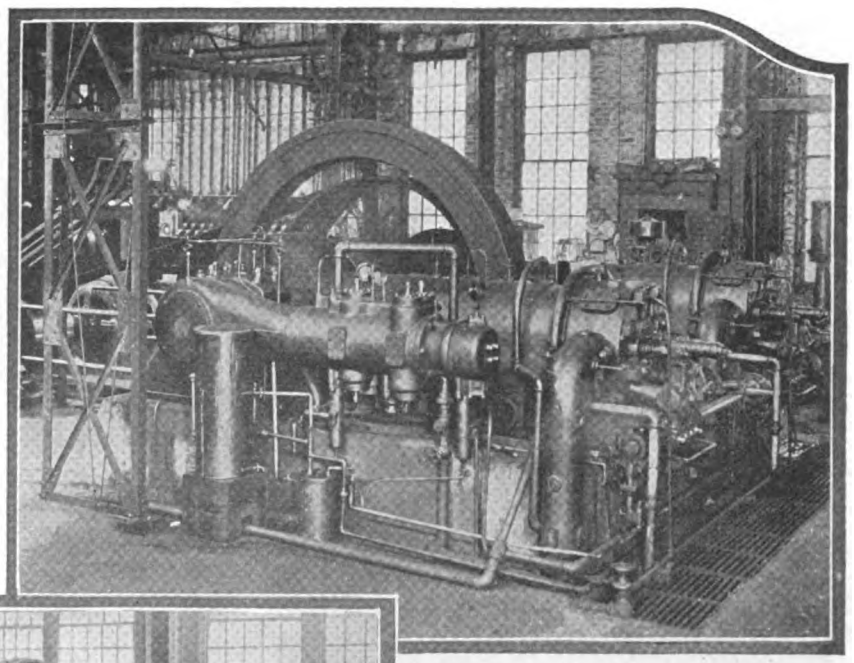
f the Diesel Engine

this most Efficient Prime Mover

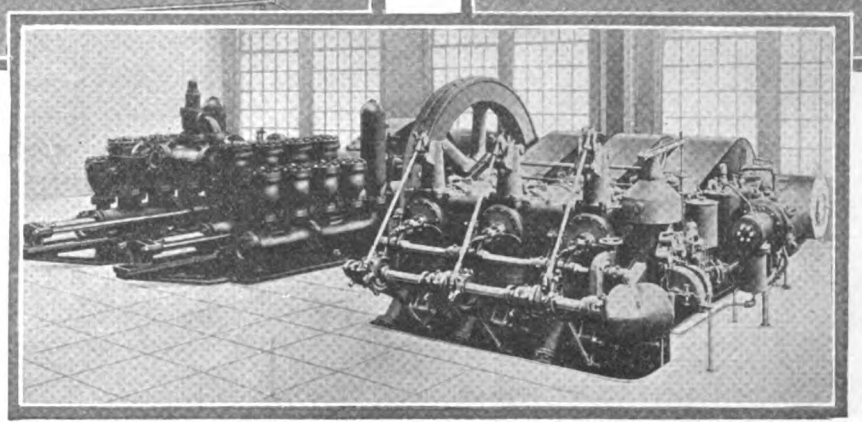
MSON LEES



ne of the first large-size Diesel ngine plants built in this coun- y. In it are two original 1250 . P. engines bought from Carels reres, Belgium; two duplicates these, built by the Nordberg fg. Co.; and two 750 H. P. iesels connected to air com- ressors. This plant is at yrone, N. M., and supplies ine and town with light and power.



A 150 H. P. Diesel engine in the plant of the National Transit Pump & Machine Co. This company, in common with most Diesel manufacturers, uses its own product in power generation.

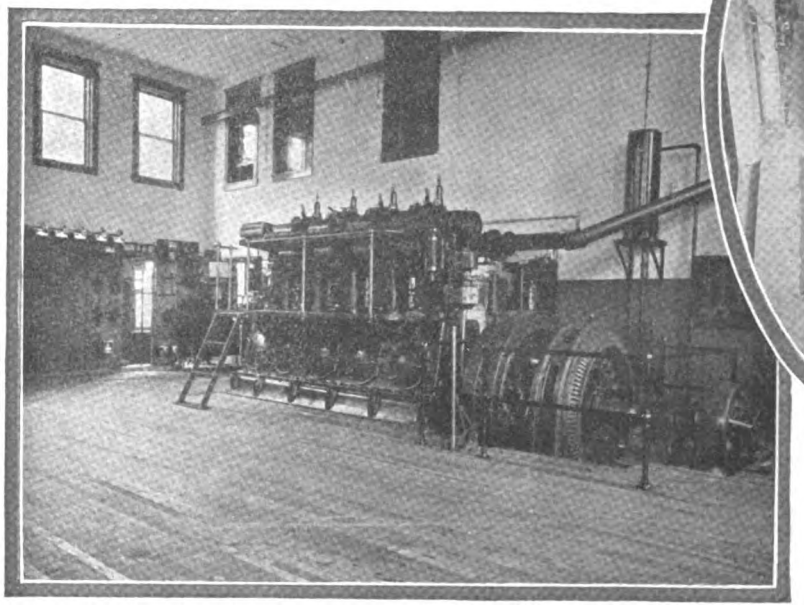


An Allis-Chalmers Diesel engine, operating plunger pumps at the oil pipe line pumping station of the Yarhola Pipe Line Co., Oklahoma.

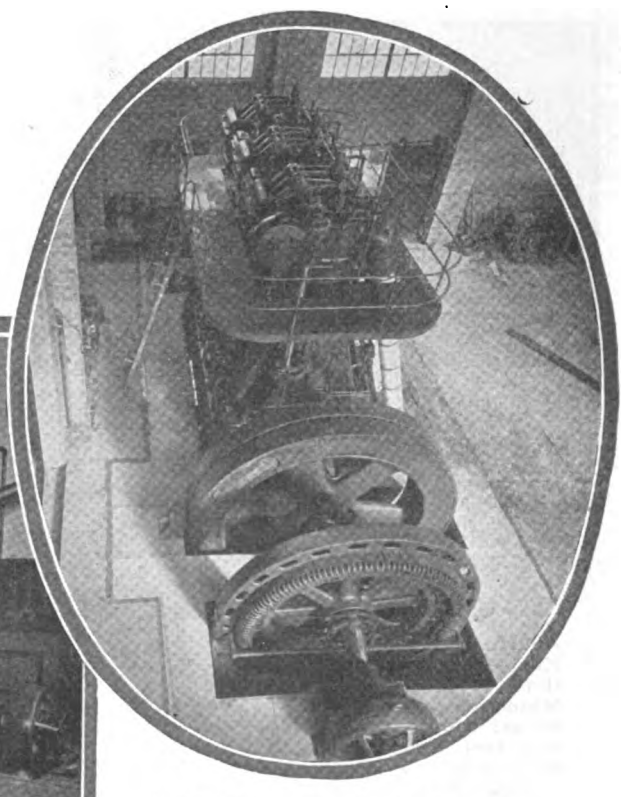
se figures, by the way, are theoretical, but are taken m actual operating condi- ns in going plants.

To understand why and how Diesel engine obtains a l-to-power-efficiency from ir to eight times that of an lustrial steam power plant, d to explain why its recogni- n in this country has been h a slow process, it will be essary to take up briefly ne of the salient points in history of power develop- nt.

The field first successfully aded by the Diesel engine this country was the marine wer field. The elimination coal storage space, the sav- g of engine-and-boiler-room ace, and the general advan- ges of liquid fuel, all com- ed to give the Diesel engine hearing from marine inter- s. In the central power sta- n, too, this engine began to eive attention; probably be- use the central power station st sell its power, and is thus oroughly awake and ready to vestigate anything which omises more economical

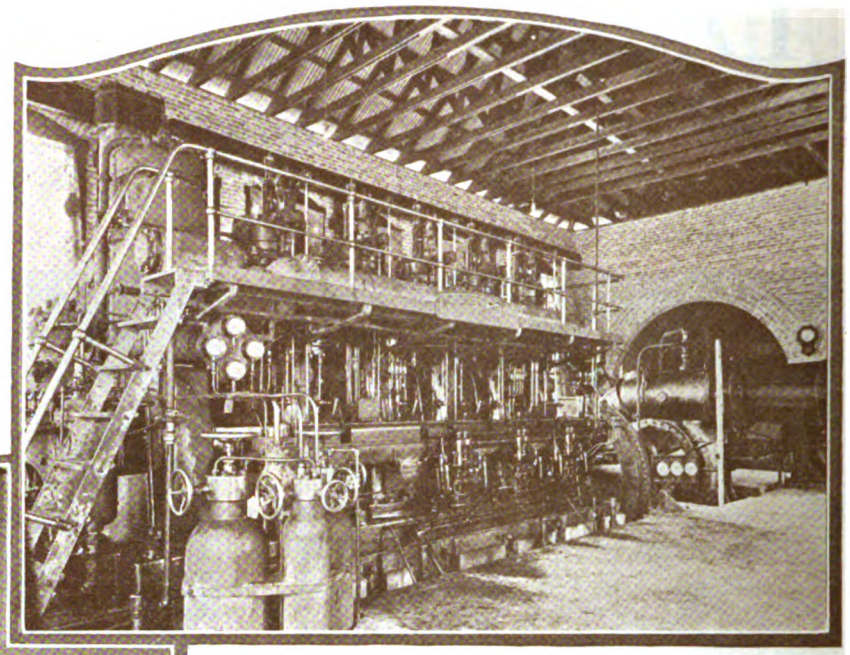


A Busch-Sulzer Diesel engine at Holstein, Iowa. Note the typically clean engine room, and bear in mind that there is no boiler-room or coal storage in the background.

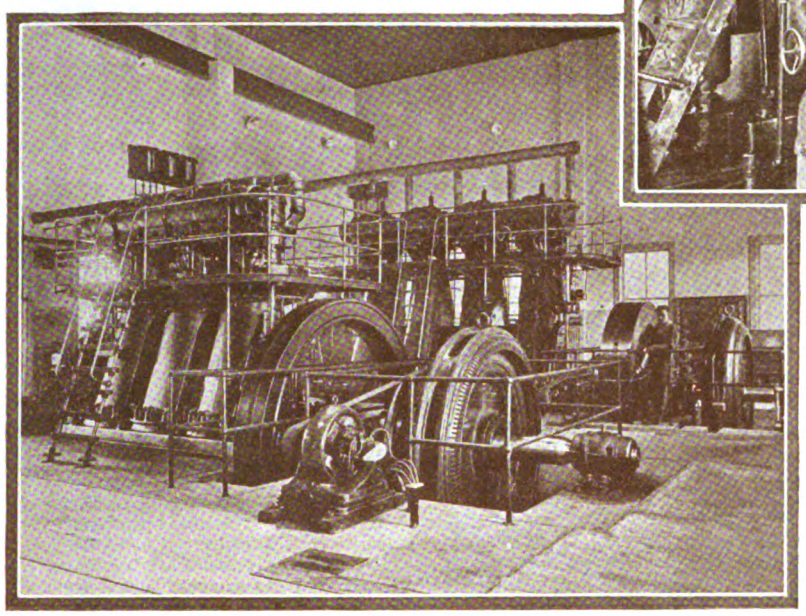


A "bird's-eye view" of the engine which appears on the cover of this issue—a 520 H. P. Diesel Engine recently installed at the municipal power plant at South River, N. J., where it replaced a producer-gas installation.

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Pumping water to irrigate 25,000 acres of land at Mission, Texas. This 550 H. P. Nordberg Diesel engine saved more than $400 in fuel in its first four days, after replacing an oil-fired steam installation.

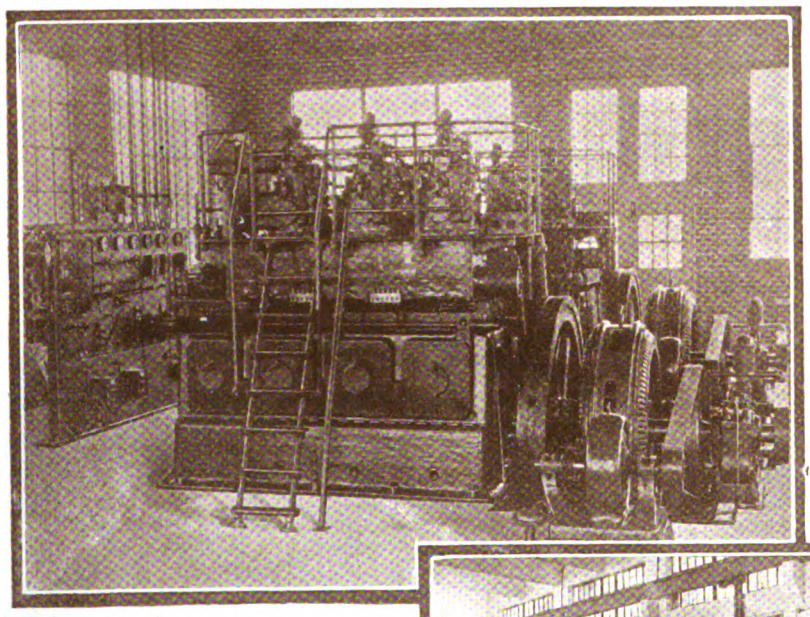


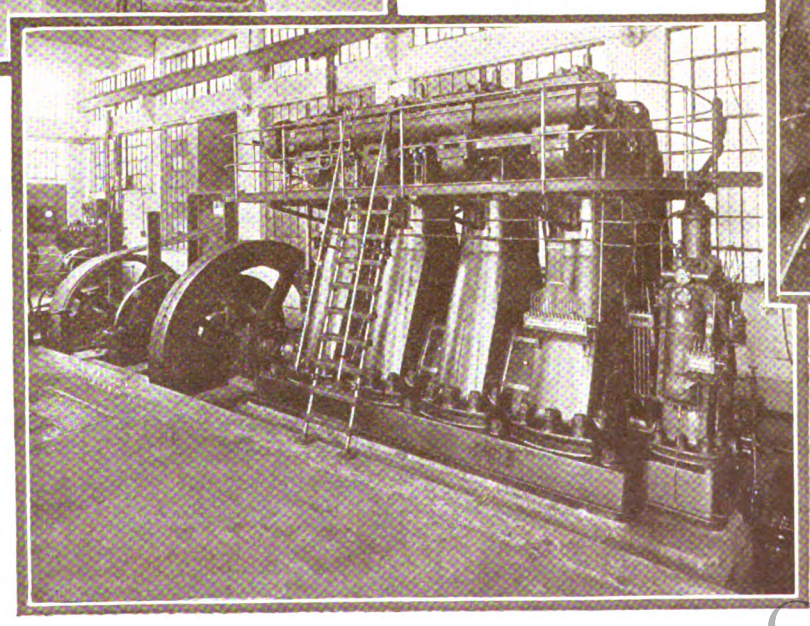
The Municipal Power Plant at Algona, Iowa. Starting with one 200 H. P. Fulton-Diesel in 1918, this plant installed a second, of 425 H. P., in 1920, and in April of this year (not shown here) a third—a common occurrence in Diesel engine experience.

power. The industrial field, strange as it seems at first glance, stubbornly resisted the idea from the start.

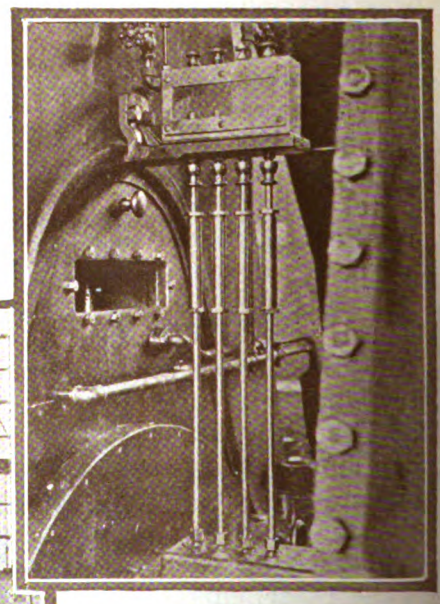
It must be remembered, however, that the industrial power field is steeped, for the most part, in the traditions of steam power; and, as a group, industrial power users are so slow to adopt improvements that this one factor alone is responsible for the low average efficiency of 7 per cent in industrial power plants as a whole—where better methods and available equipment would, if utilized, easily show an increase of from two to four per cent. Until recently, the average plant executive had little interest and less knowledge concerning his power. He le that to his power engineer, a the latter was a dyed-in-th wool coal and steam man; n did it occur to the executive t look upon power as a commo ity which must be produc economically, but rather as raw material which had to b had, at whatever cost. B those "good old days" pass when prices tumbled, and no a-days power costs are amo the very live topics at dire tors' meetings.

There is a rather prevale impression among laymen t the internal combustion engi was conceived only after t steam engine had been ma practical; that it was the r sult of a seeking for a bet





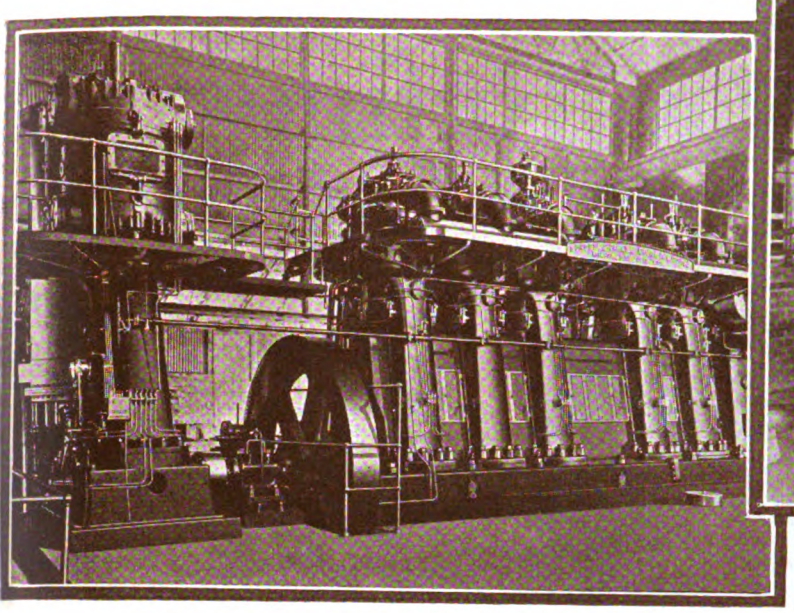
Above—Two "Standard" Diesel Engines of 150 H. P. each, at the West Point, Nebraska Municipal Light and Water Plant; where they reduced the fuel cost from $60 to $8.39 a day—with coal at $9.15 a ton, and oil at 6½c a gallon.



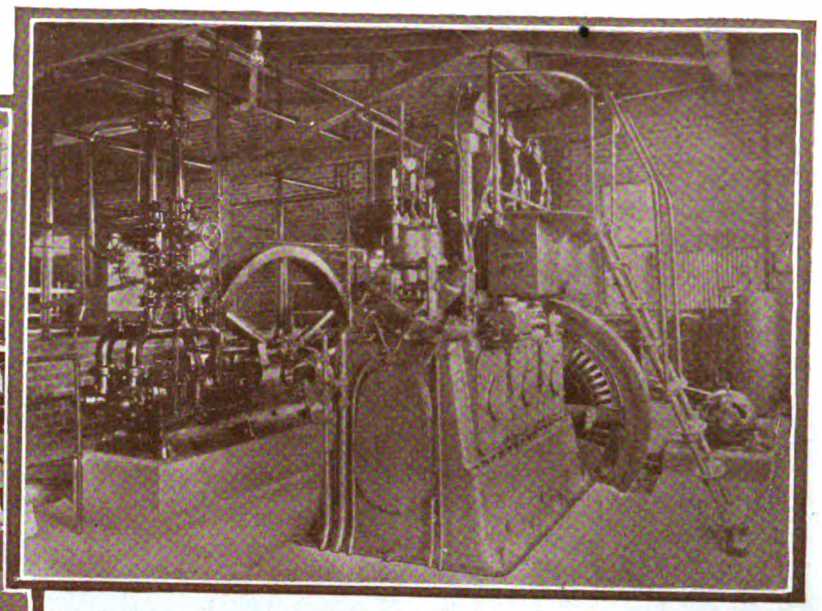
Close-up of sight-feed lubricator—one of the comparatively few and simple things the Diesel operator keeps an eye on, in contrast to the many dials and gauges of a steam plant.

A typical flour mill installation:—585 H. P. Fulton-Diesel at the Standard-Tilton Milling Co., Dallas, Texas, in operation since December, 1919.

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A Nordberg-Carels Diesel of 1250 H. P. at the Morenci Branch, Phelps Dodge Corporation. This engine, normally running at 180 R. P. M., is governed automatically by the compressed-air demand which it supplies, and is often cut down to 55 R. P. M.—an illustration of the Diesel's flexibility.



At the Bucyrus Ice & Cold Storage Co., Bucyrus, Ohio; a 100 H. P. "Standard" Diesel engine which is claimed to save $1.03 per ton of ice produced, over the former method, of buying power from a central station.

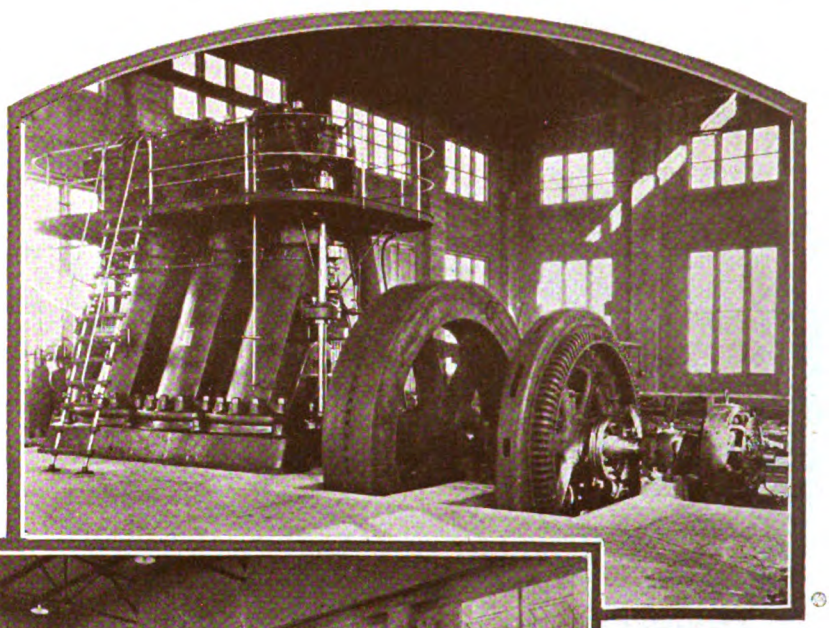
power unit than the steam engine. On the contrary, internal combustion engines had been built and used long before Watt's time. But the defects of these early types were so great that, when Watt made the steam engine a practical thing, interest in power development became centered upon steam; with a resultant lapse in the development of the internal combustion engine.

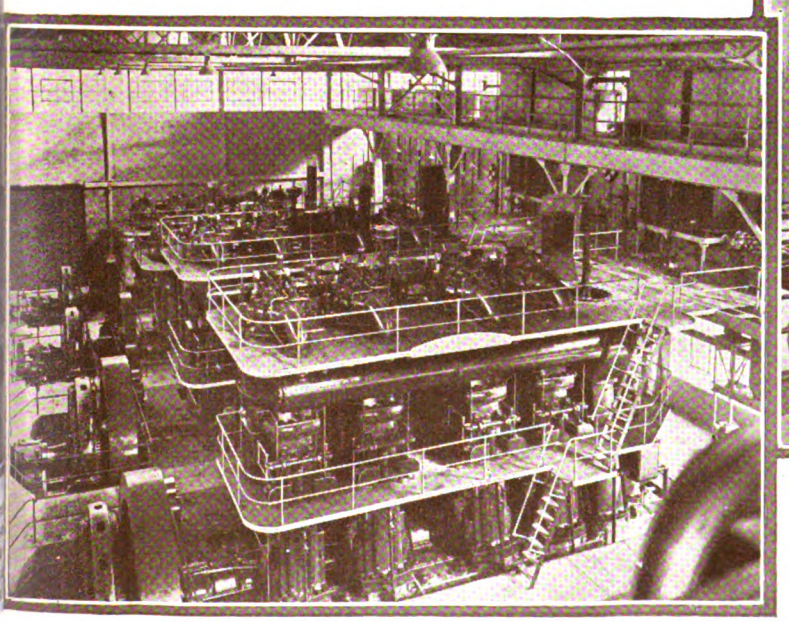
The fuel suggested for use in these early engines was gunpowder; but defects in construction prevented any tangible results with this rather capricious "fuel." After men had learned something about the distillation of coal, a better fuel became available, and several internal combustion engines were developed for the use of coal gas; these really being the forerunners of our modern gas engine.

By the time (1876) Otto's silent engine was exhibited at the Paris Exhibition, creating a great stir by its radical improvements, experimentation had already begun with the use of volatile liquid fuels for internal combustion engines. These experiments finally led to our modern gasolene engines,

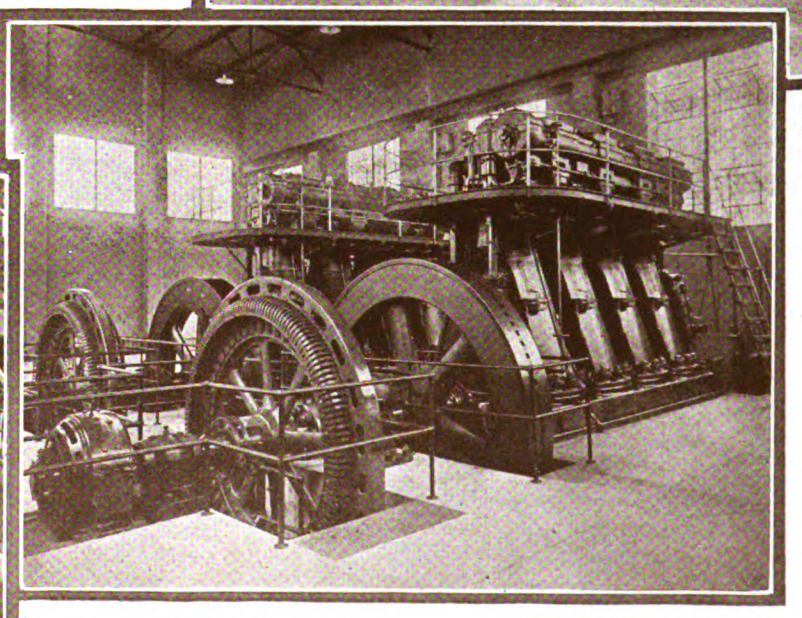
(*Continued on Page 54*)

This Fulton-Diesel (below) of 500 H. P., installed in 1919 at the Miami, Oklahoma, Municipal Plant, replaced steam equipment. A second Diesel was installed here in August, 1921.





At the Copper Queen Branch, Phelps Dodge Corporation, Bisbee, Arizona; two 1250 H. P. and two 2,000 H. P. Nordberg Diesel engines—the latter having the largest power cylinder built in this country to date—28" x 44". These "big ones" weigh some 350 tons.



A typical cement plant installation Fulton-Diesel at the Texas Portland Cement Co., Houston, Texas. One engine installed in May, 1916, the other in August of that year.

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Material Handling in the World's Most Modern Sugar Refinery

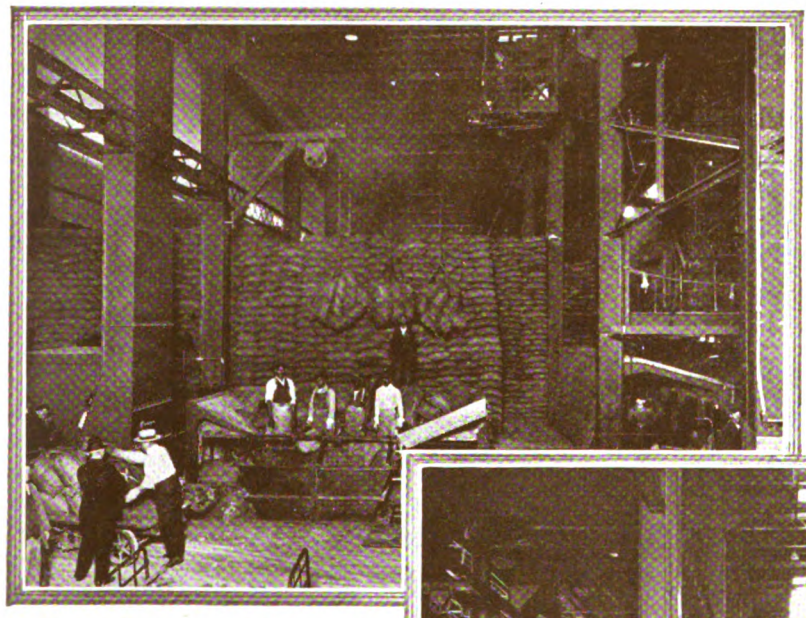
By Homer L. Rank



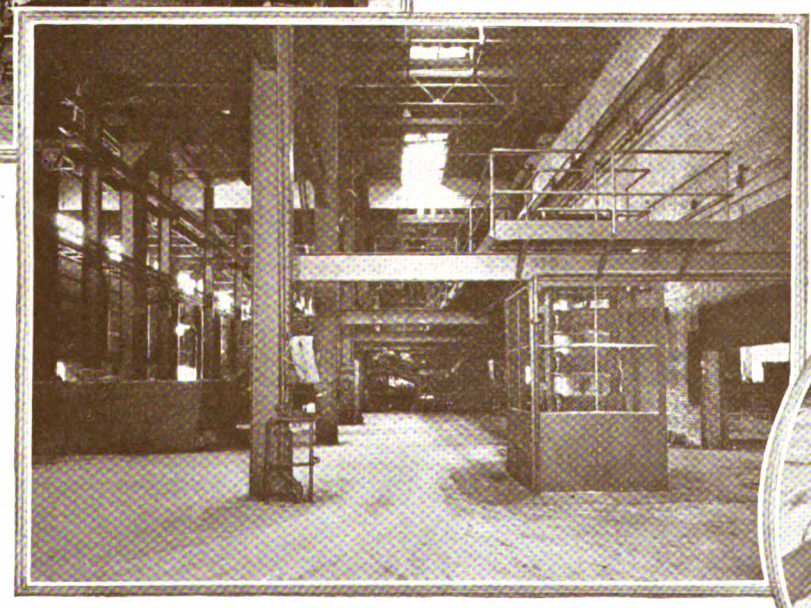
Arriving at a Refinery in the United States, bags of raw sugar are unloaded by means of the ship's winches. Electric trucks then haul the bags over Government scales, where they are carefully weighed, for import duty.

FOOD, or high explosive? Sugar, or gun-cotton? How many of you who read these words realize the slight difference, from a chemical standpoint, between one of the most important foods and a much-used explosive? For the chemical formula for sugar is C_{12} H_{22} O_{11} while that of commercial gun-cotton is C_{12} H_{20} O_{10}, combinations of nature's elements which vary mainly in the proportion of hydrogen content, though used for widely different purposes—and certainly contrasted results!—in our daily lives.

Naturally, the factories in which these closely related chemical compounds are prepared, differ greatly. 9,280,000,000 pounds of sugar were refined and consumed in the United States, in the year 1921. The most modern plant in the world, for refining cane sugar has recently been completed and put in operation at Baltimore, Maryland. For over 2,700 years sugar for food has been extracted from the juices of certain plants, with varying degrees of purity; but with constant improvement of method and process during the passing years. Today, the demands of our modern civilization and

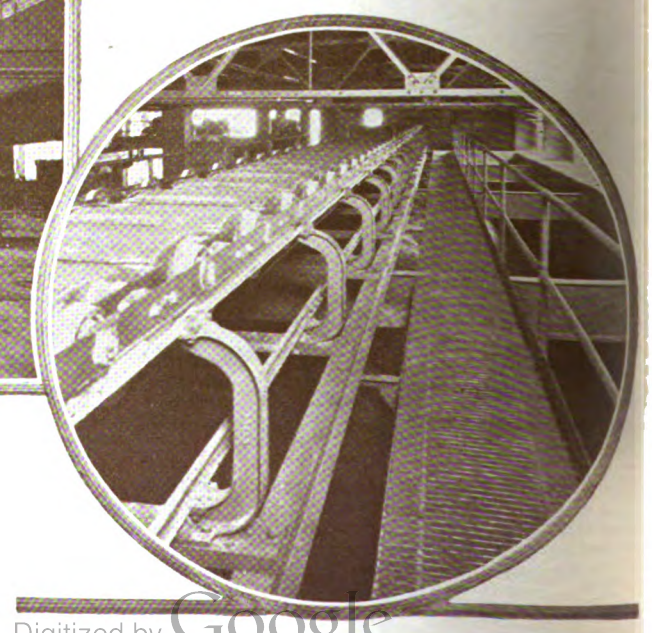


After being weighed and sampled (man with straw hat is a sampler), the bags are hoisted by high-speed electric cranes and either placed in storage piles, or deposited upon cutting tables to be opened. Crusher in foreground; conveyor directly under it, and to the extreme left.



Sugar may go directly into refining process, (see conveyor under skylight), or may be carried to storage bin by conveyor in the foreground. Returning, this conveyor brings sugar from storage, and deposits it into either of the two elevating conveyors, first mentioned.

Another view of the long conveyor shown in picture (3), showing raw sugar being dumped into a three-million-pound storage bin. Note the sugar, piled like so much sand, in bin below the walkway. This bin "feeds" the refinery at night.

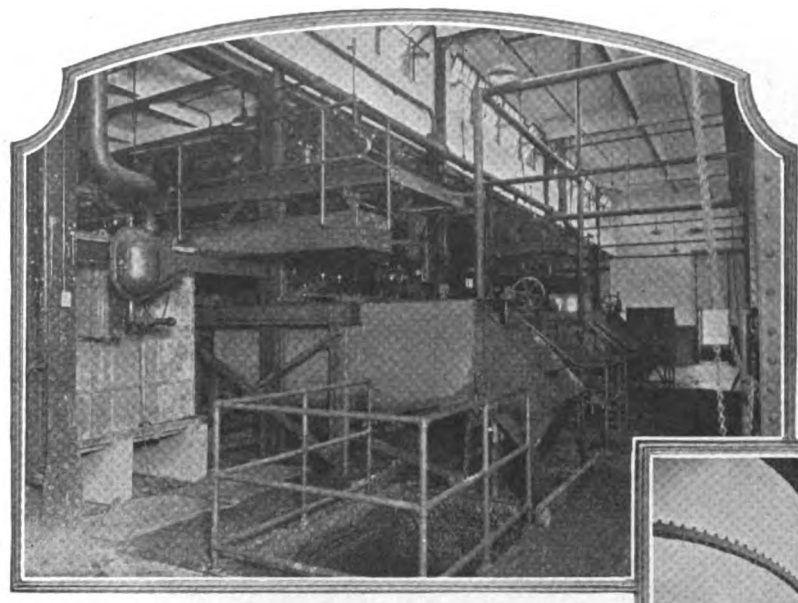


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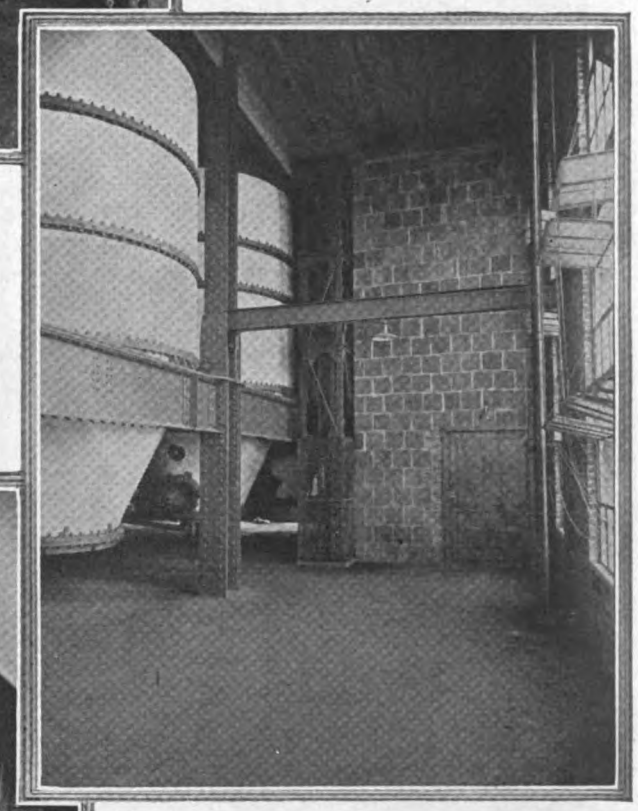
scheme of commercial economics are such that—in foods—we must have the highest grade of product, uniform in quality and purity, yet produced at a minimum cost.

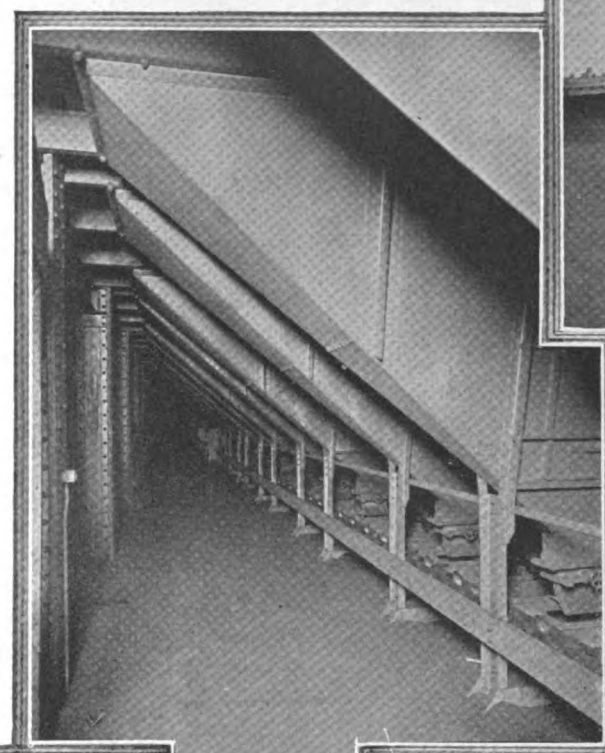
To obtain these uniform results at low cost, the process must be mechanical as far as possible, particularly the conveying of both raw and refined material between process units, machinery must now do the work, which, for centuries, has been done with human hands. In the Refinery above referred to, every effort has been made to minimize the amount of non-productive labor required to carry on the process of preparing sugars for the discriminating American housewife. As a matter of fact, every grain of sugar passes through the entire refining and packing process, without being touched by human hands. When designing and building this Refinery, no reasonable expense was spared for material-handling equipment and automatic devices. This does not mean that money was literally "thrown away"—on the contrary, months of time and study were spent in reaching decisions regarding the *judicious* expenditure of capital, for equipment that would "stand up" under the unusually severe treatment ordinarily given mechanical equipment in a plant of this character.

For the sugar-refining process is continuous; the machinery must function twenty four hours a day, with occasional stops on Sundays. In the new refinery at Baltimore,



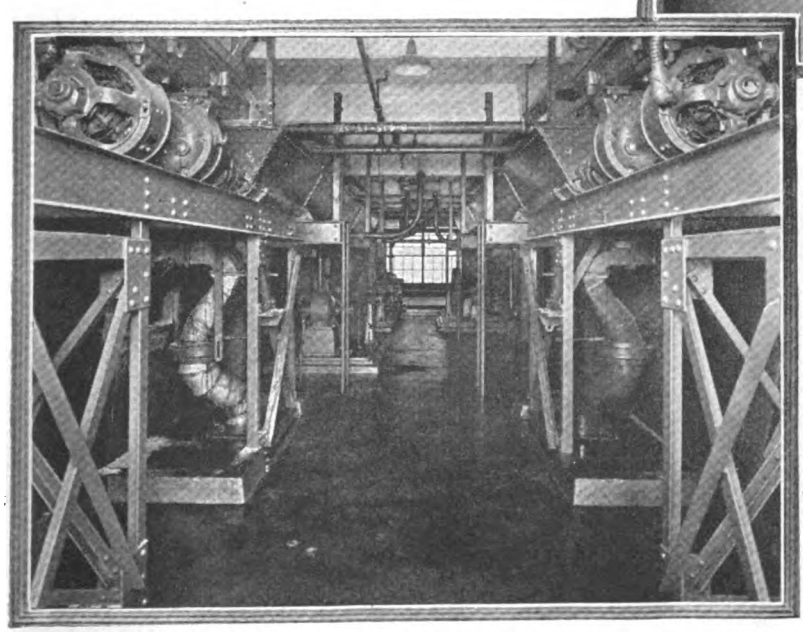
Raw sugar, started through the refining process, is elevated to the 7th floor of the "Wash House," which, as the name implies, is the "laundry" for this sugar. Note the two tanks (center) into which either of the two conveyors dump.



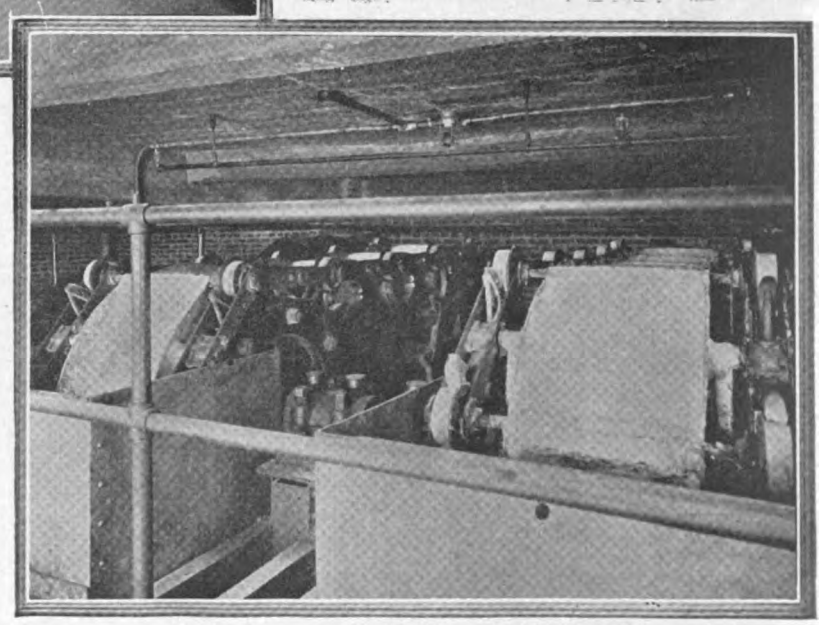


After being "washed," the sugar now in liquid form, must be carefully filtered. Tank shown contains 35 tons of the filtering medium—bone charcoal. Note close clearance of conveyor between tank and wall; four conveyors handle all the char used.

After 48-hour periods of use, the char must be revivified by washing and re-burning. A continuous stream is conveyed from the hoppers shown here, and elevated to the top of tanks shown in preceding illustration, a system never previously used in a refinery.

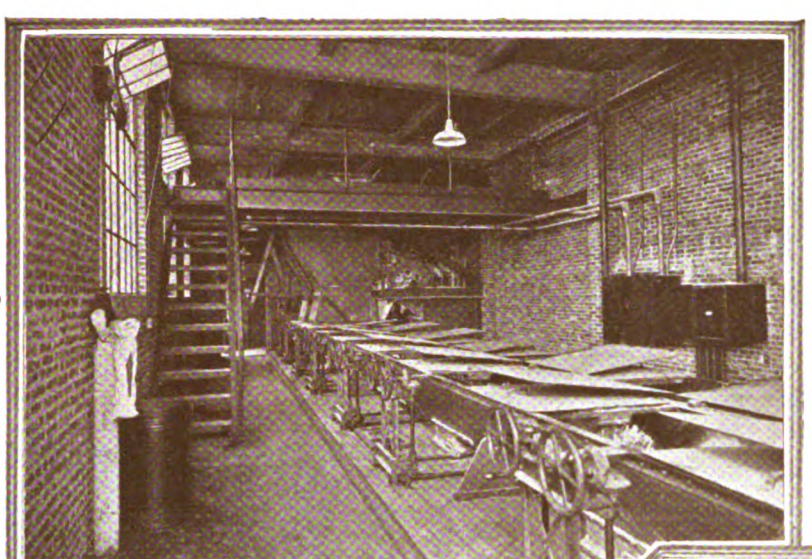


Special spiral conveyors, shown here, carry refined sugar (containing a small percent of moisture) from centrifugal machines to aluminum bucket conveyors, which in turn convey and elevate to the "Finishing Building."



Refined sugar, pure white and clean, being discharged at top of "Finished Building." Note close clearance overhead, due to structural limitations of the roof.

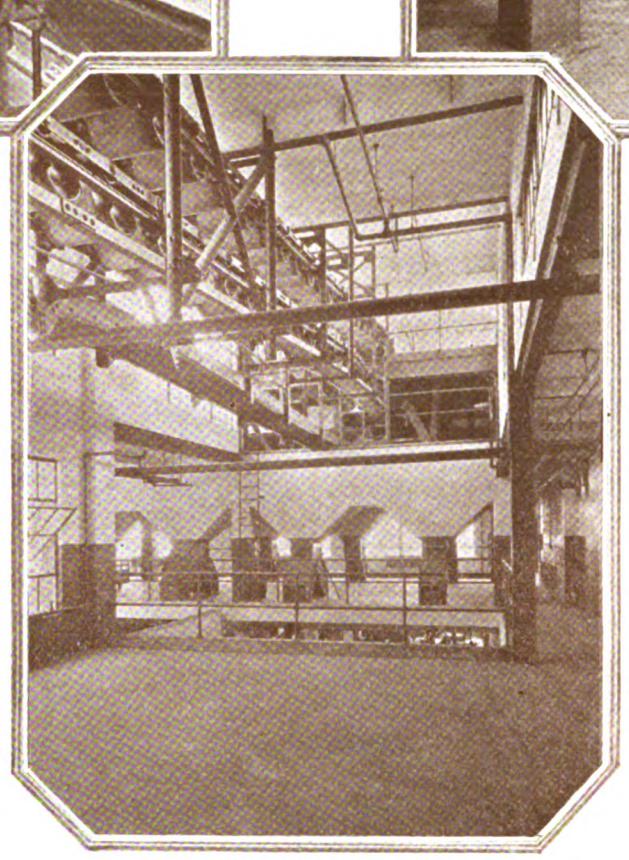
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Moist, refined sugar, discharged from either of the aluminum bucket conveyors in the background, is distributed over the storage bins by two spiral conveyors. Note the convenient operating mechanisms for gates in both troughs.

there are material-handling devices which have never been previously used for the purpose, in this country, and some which are totally new to the sugar refining industry, world over. There can be no loss of time or delays to the various costly processing units, due to faulty or inadequate connecting links—the conveyors—and in this refinery all the elements are effectively coordinated by the conveying system to be described, and shown in the accompanying protographs.

Raw sugar (resembling in appearance the "old fashioned brown" sugar, with which most of us are familiar), reaches this modern Refinery in 325 pound burlap bags, having been shipped by steamer from Cuba, Porto Rico, the



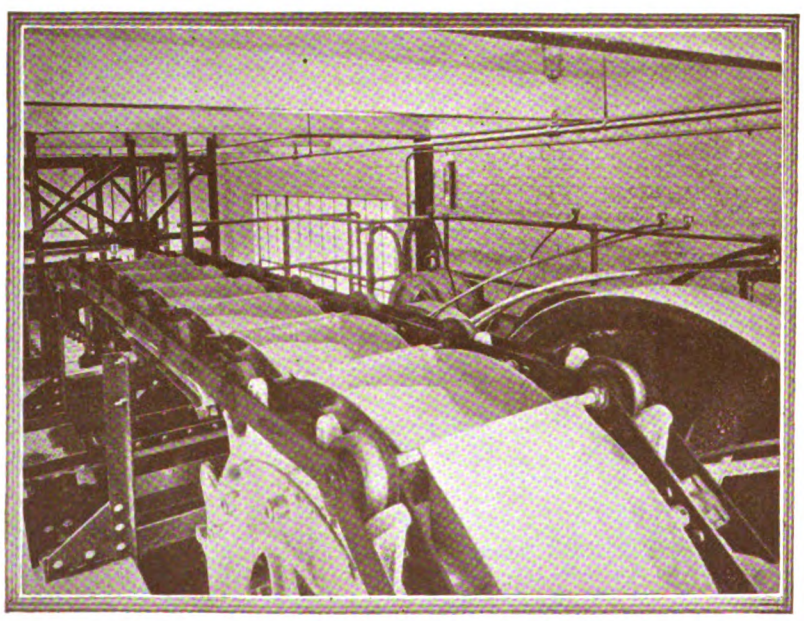
Having traveled along under storage bin, the sugar is elevated 110 feet and now traverses the span between finished department and parking room. Note flood of light and total absence of dust—the photograph has not been retouched.



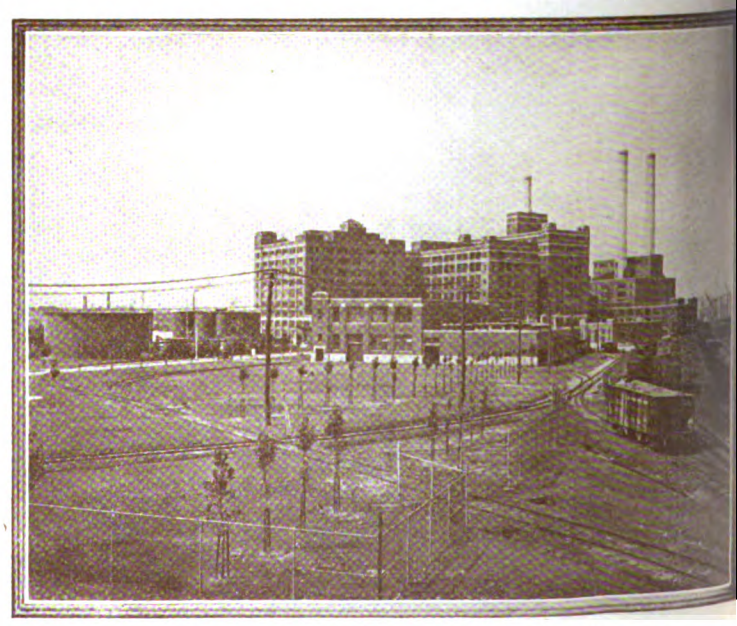
After being dried and screened into the several commercial sizes, sugars are deposited into a three-million-pound storage bin, from whence it is packed in barrels, bags or cartons. View shows aluminum bucket conveyor on its way from storage bin to carton filling department.

Phillipines, Java, and other tropical countries. The bags are unloaded by ship's winches and gear and landed upon storage-battery trucks on the dock. Each truck load is accurately weighed, once over Federal Government scales (for import duty) which are tested hourly, and again over the refinery scales, the contents of each bag being sampled after weighing. From this point the sugar may take either one of two courses, into temporary storage in bags or in bulk, or go directly into the refining process. Bags which go into storage are lifted from the trucks by high-speed electric cranes, three "slings" to each crane, and seven bags in each "sling." The raw sugar warehouse is of

(Continued on page 51)



Dry, refined sugar, perfectly clean, discharging from aluminum bucket conveyor into bins over carton-filling machines, at the rate of one hundred thousand pounds per hour.



The huge task of producing and selling CLEANLINESS is being successfully performed, mechanicaly, by the American Sugar Refining Company, in this remarkable group of buildings.

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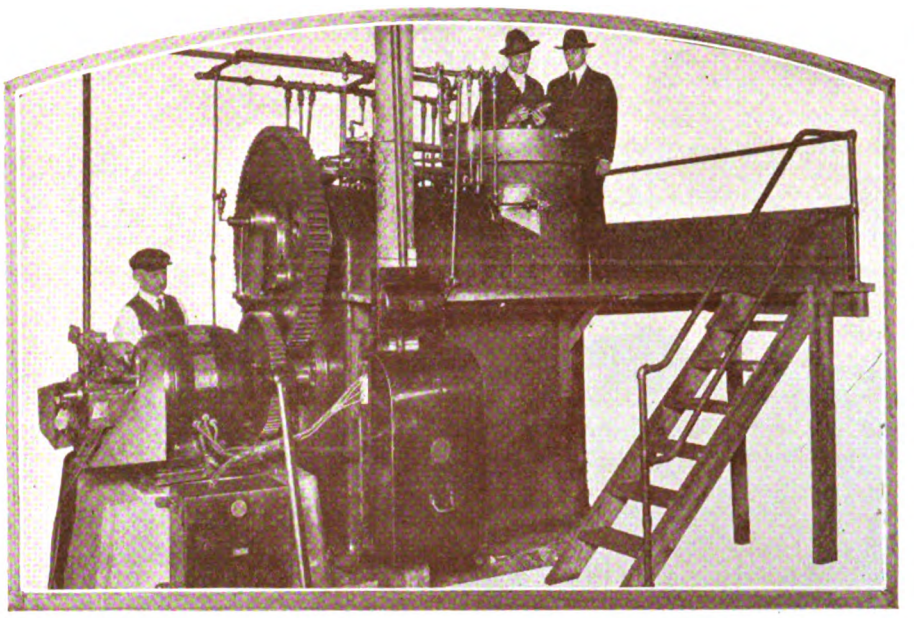
Cutting All the Teeth of a Gear at Once

THE machine here shown differs from the usual type of gear cutting achines in that it cuts *all* a *multiple number, of eth* in a gear or similar oduct at one operation as stinguished from cutting e tooth at a time as is ornarily done on standard achines.

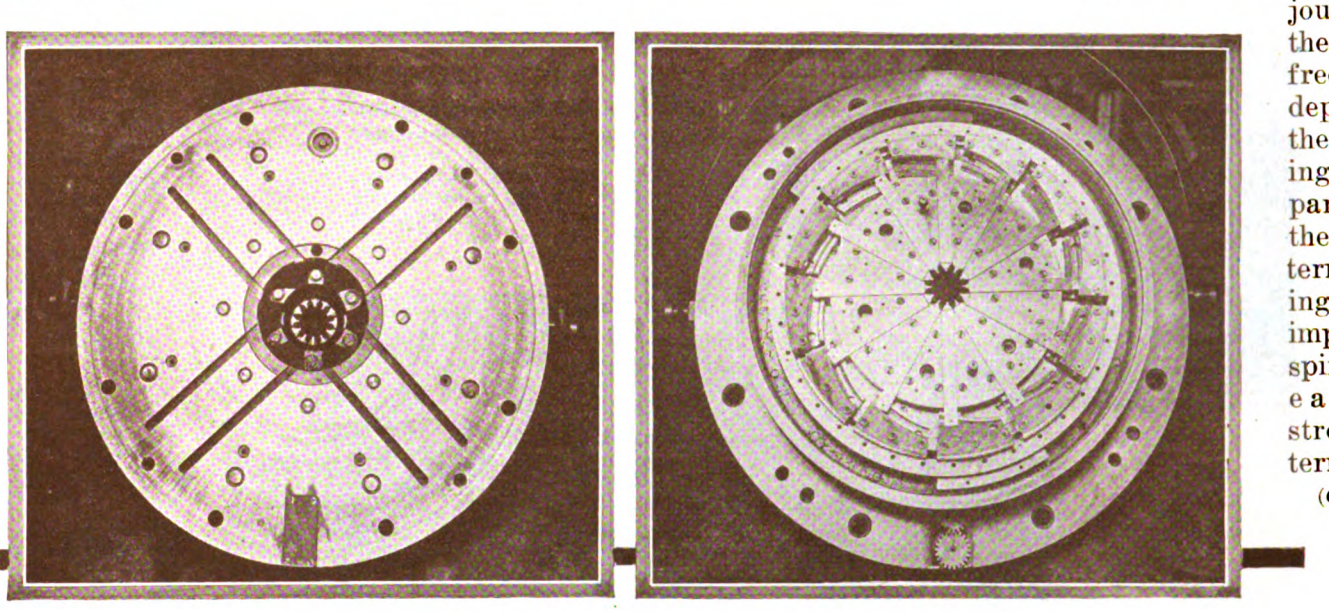
The essential member of e machine is a special tool ad which consists primarily a series of radially disosed tools spaced about the rcumference of the blank to cut.

This machine operates in e same manner as an ordiny vertical shaper, except at the tools e held stationy and the gear ank is reciprocted past the ols. The mechism of the maine consists sentially of a m carrying a ank supportg arbor and ıe multipleoled head for erating upon e blank. The frame of the machine is a casting of rectangular box section with a vertical cylindrical portion at one end. The ram is mounted in the center of the cylindrical part of the frame and the tool head is mounted above the ram at the top of this portion. The crank shaft which drives the ram is journaled near the top of the rectangular section and is provided with an adjustable crank head at the end next to the ram, being driven through back gears by an individual electrical motor. The arbor which carries the gear blanks is not made solid with the ram, but fits in a socket in a spindle which is journaled inside the ram and is free to rotate independently of the reciprocating motion imparted to it by the ram. An intermittent indexing movement is imparted to the spindle, after each cutting stroke, by an intermittent gear

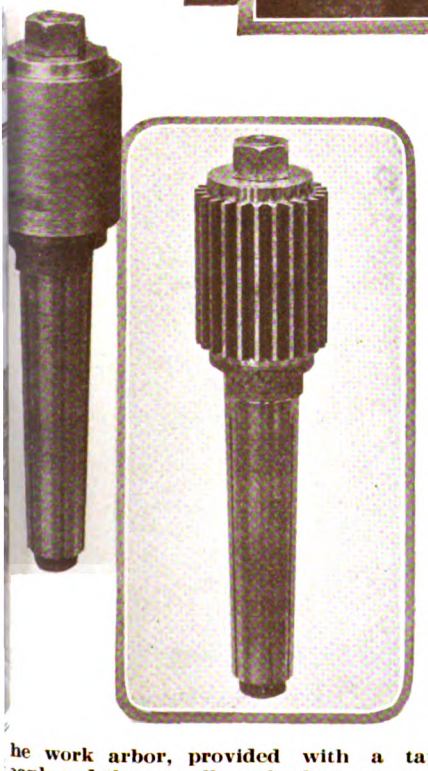
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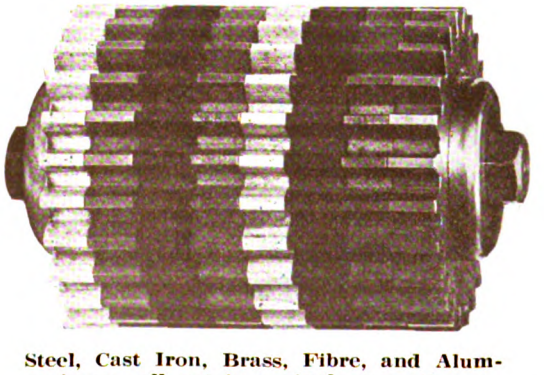
A machine which can cut, not one, but all the teeth of a gear at one time.



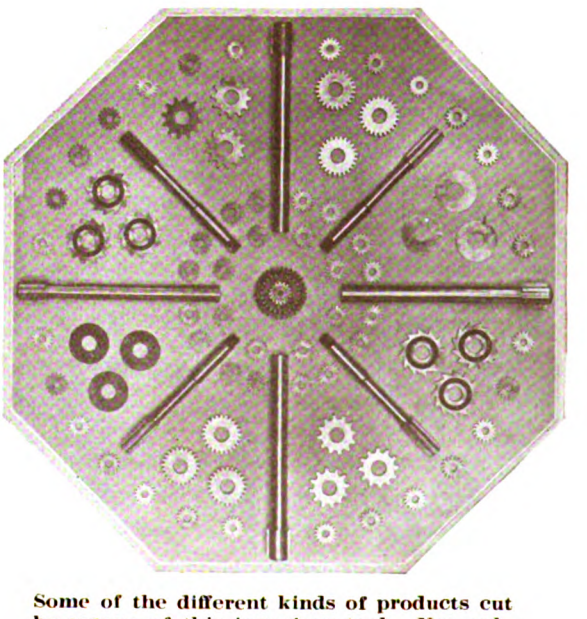
The tool head as it appears on the machine, is shown above at the left; while at the right is a view of the head partially disassembled, showing the details of cutting tools and feeder mechanism.



he work arbor, provided with a taper ank and thrust collar; the latter preventg taper shank from being thrust too tightly into the socket.



Steel, Cast Iron, Brass, Fibre, and Aluminum—all cut in a single operation.



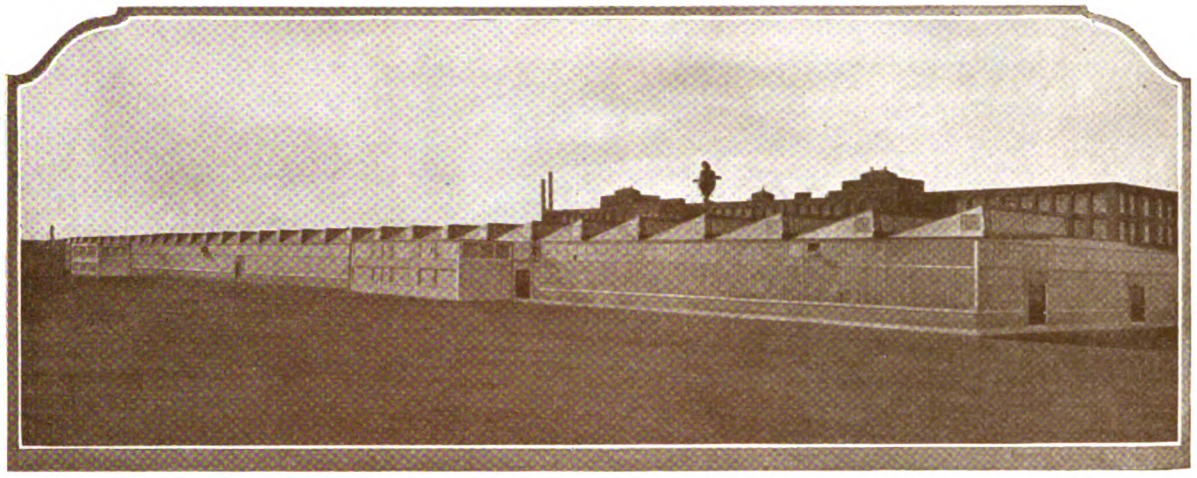
Some of the different kinds of products cut by means of this ingenious tool. Not only gears, but reamers and milling cutters lend themselves to this method of production.

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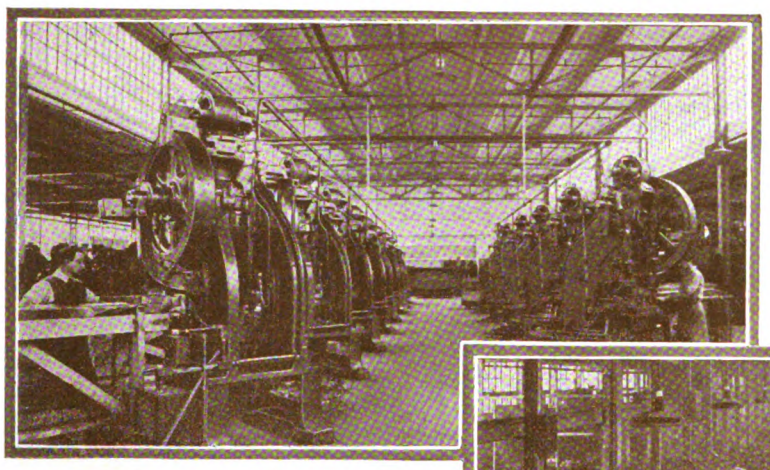
Graphics as a Production Stimulant

How It is Applied to Westinghouse Automotive and Radio Equipment

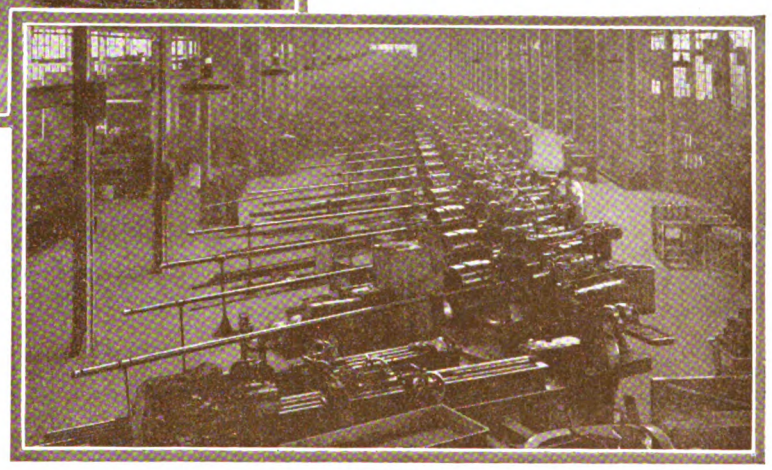
By John H. Van Deventer



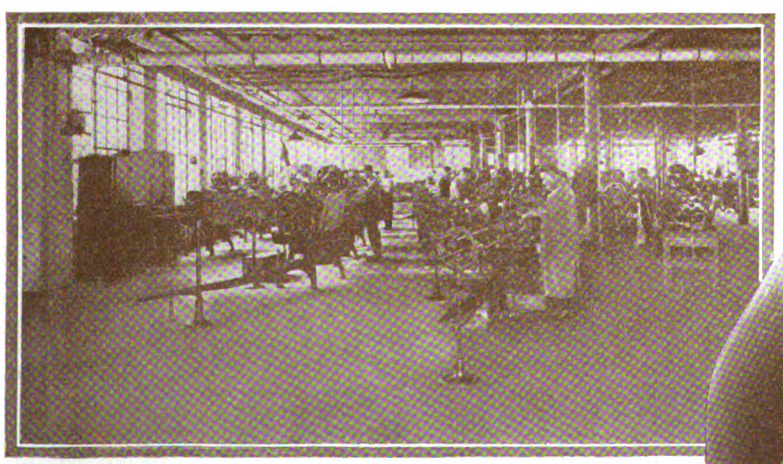
View of the automotive equipment building, a one-story construction in which the flow of material is all one way. Raw materials enter at one end and finished starting and and lighting units come out the other.



The press department, where millions of armature laminations are stamped for thousands of small armatures. The stock, thin strips of special steel, is fed automatically by "roller feed" devices attached to each press.



Battery of automotive screw machines in the "feeder" department. Note the individual motor drive and the angular placement of machines to economize space.



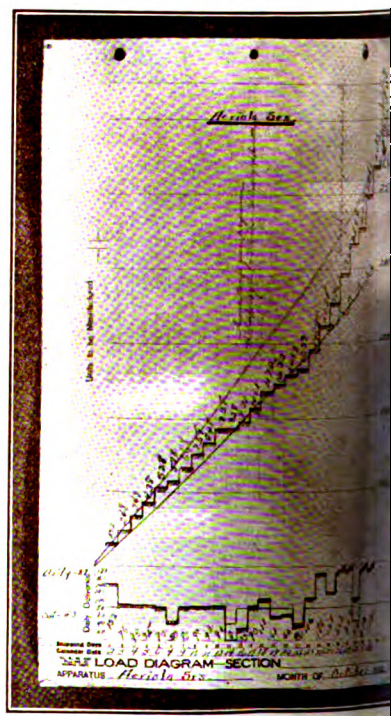
A group of four-spindle automatics is shown here, also with individual motor drive, a great saving on belts slippage and power, the latter particularly for overtime or part time operation.



PRODUCTION at the East Springfield Works of the Westinghouse Electric and Manufacturing Company presents unusual features of interest to industrial executives and engineers. The first feature is the departmentalization or the dividing up of the work to be done and its segregation. The second point of interest is the handling of an immense total production made up of an extremely great variety. The third and most interesting aspect perhaps is the graphic methods employed to check and stimulate schedule output.

Departmentalization in a parent company, such as the Westinghouse, goes much further back than the matter of dividing work and of sending it through suitable departments in any one plant. It goes all the way back to the question of how big the plant itself should be to economically pro-

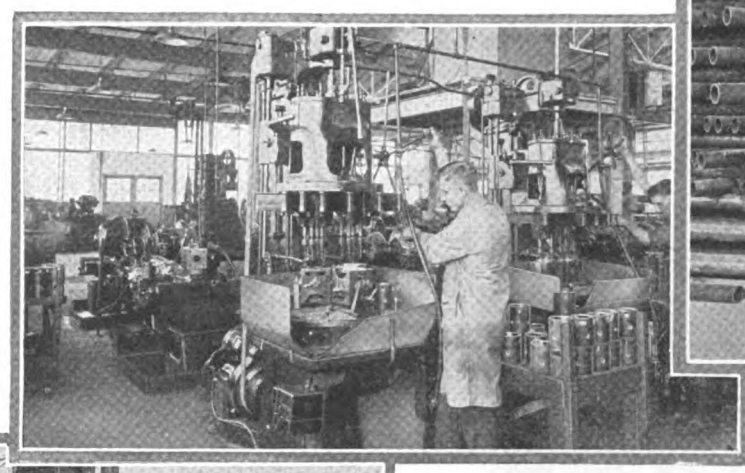
Below is a "load diagram" chart which the quota for the month has been indicated by the unbroken inclined line. The cumulative shipments recorded daily show how the quota has or has not been met.

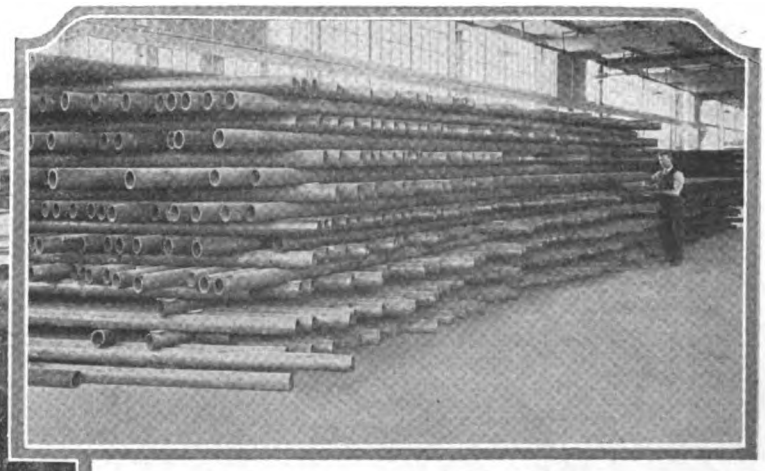


Center—Checking up on a drilling jig, in the tool room. Dimensions to the ten thousandth part of an inch are easily obtained by means of the standard blocks seen in the wooden case.

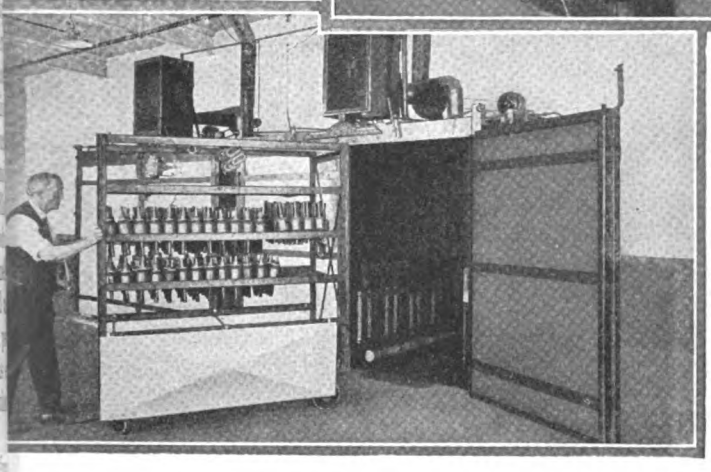
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er the starter motor mes have been bored and ned on "Mult-Au-Matics," y are jig-drilled as shown e. Note the type of shop cks employed to prevent pping and lifting by operators.

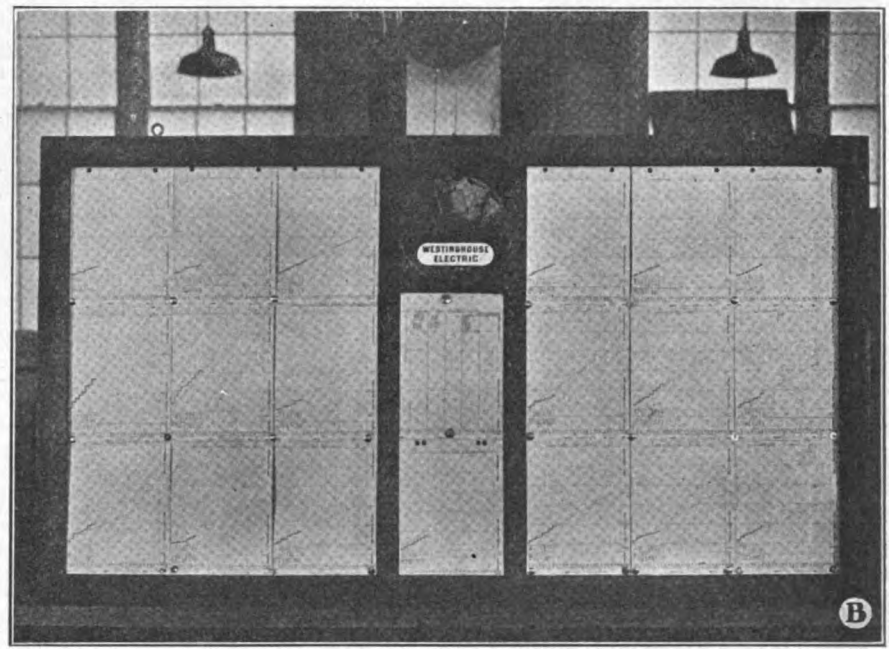




Starter motor and generator frames in the "rough." Heavy steel pipe is used for this purpose, this being cut to suitable lengths and machined all over.



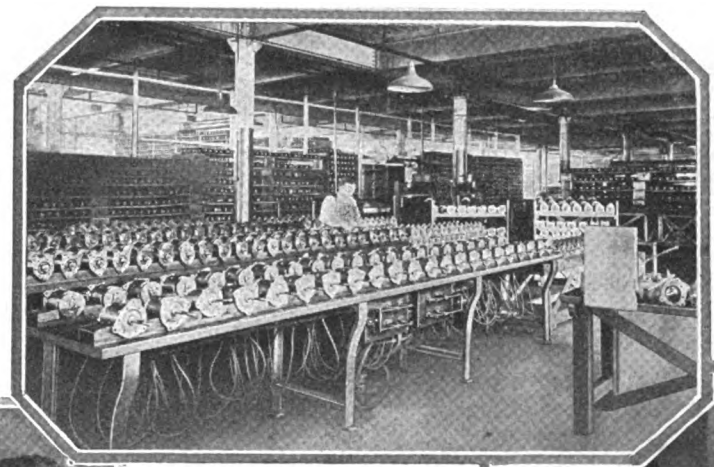
Armatures are "baked" in electric ovens to harden the insulation.



View in one of the manufacturing departments showing "load diagrams" posted on the bulletin board. This lets everybody know how the department is meeting its production requirements.

e a certain product and to equally important question how big it *should not be* if it to be kept from becoming wieldy and inefficient. For a nt that is too big is often in serious a condition as one it is too small. When any tory gets so big that its rks manager and superindent, for example, are out touch with material, mechanl and human details, it is approaching the "saturation nt" for profitable operan.

The East Springfield Works, ere starting motors and nerators, standard and cial fractional horsepower tors and radio equipment



Inspection of starter motors, after electric test. Just as soon as a motor has been "O. K'd" it is boxed, the packing tables being across the aisle to the left. Thus there is no chance of the motor being damaged in storage before shipment.

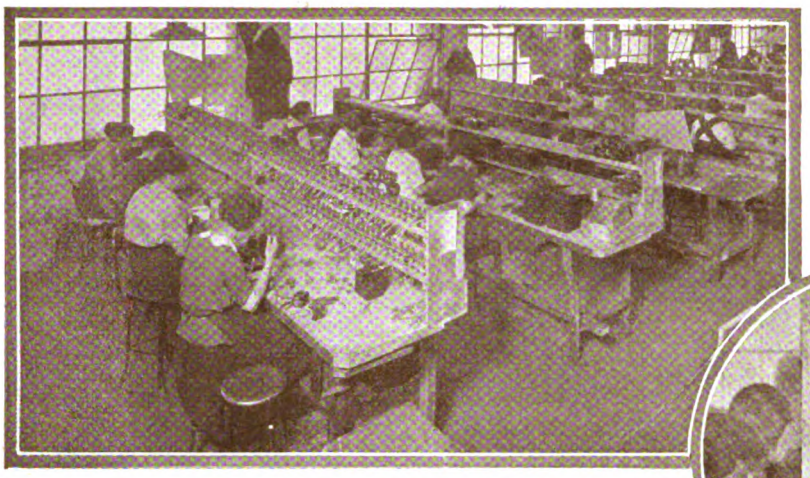


Dynamometer test of a starting motor. The "characteristics" required by each type of apparatus must be rigidly met, and are verified on the test bench.

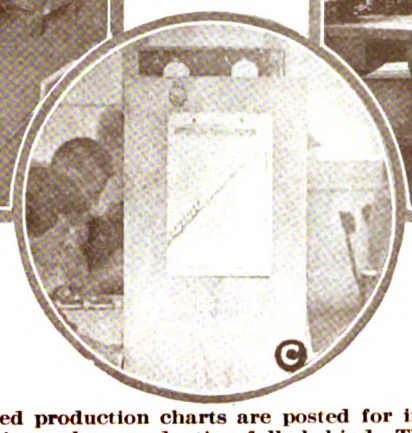


Westinghouse radio equipment is also made at the Springfield Works. This illustration shows the sorting and breaking of detector crystals, used in the less expensive sets.

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Progressive assembly is adopted for radio work. The flow of work does not require mechanical transportation. Notice the shelf at the back of each bench. Finished operations are placed here and are easily reached by operatives on the succeeding stage of assembly.



Detailed production charts are posted for individual operations when production falls behind. The moral effect is surprisingly good.

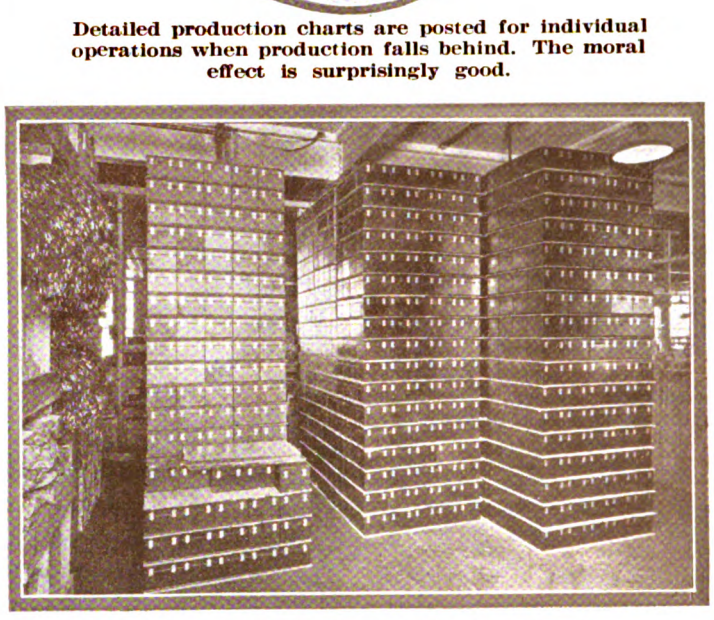


Further along in the Aerola, Sr. assembly department the sets are fastened in their hardwood cases, a supply of which is shown in centre illustration.

are made, while an integral part of the Westinghouse Company is a specialized plant separated physically from other Westinghouse plants and containing some hundred thousand feet of floor space. The plant itself has again been departmentalized to suit the needs of the chief types of product. These plant departments in addition to the foundry, stamping department, tool room and general machine shop, which are of course feeders to all departments, consist of the radio department, the standard motor department, the special motor department and the automotive equipment department. The illustrations accompanying this article show very clearly the physical arrangements of these departments as well as some of the methods employed in them.

I have spoken of the feature of an immense total production consisting of a great variety of products. This is true of almost every one of the specialized departments with the exception of the radio. Even in automotive equipment there may be thirty or forty different types of starting motors or generators in production at one time. As for the special fractional horsepower motors these vary from comparatively large one horsepower direct current motors to tiny special purpose ones that can be almost carried in a vest pocket. The quantities in which these are run through depend entirely on the nature of the orders. Lots as small as six are frequent and in quite a number of cases are confined to individual machines. Yet the total production involved is of course large as may be imagined from the fact that three thousand men and women are employed at this one plant. This feature as will be realized at once by those conversant with manufacturing problems makes the subject of production a difficult and hence interesting one.

(Continued on Page 64)



Below—An Expert "listener." One of the inspectors on the final receiving set test.





Before boxing for shipment a final electrical test is made to insure freedom from short circuits. Then the apparatus is carefully packed in cardboard containers.



Nightly deliveries of radio sets are made from Springfield to New York by motor truck. This picture shows the shipping department and an electric truck used to load the automobile seen in the background.

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Getting Out from Behind the Horse

The Career of Ellwood Haynes

By Ernest H. Rowe

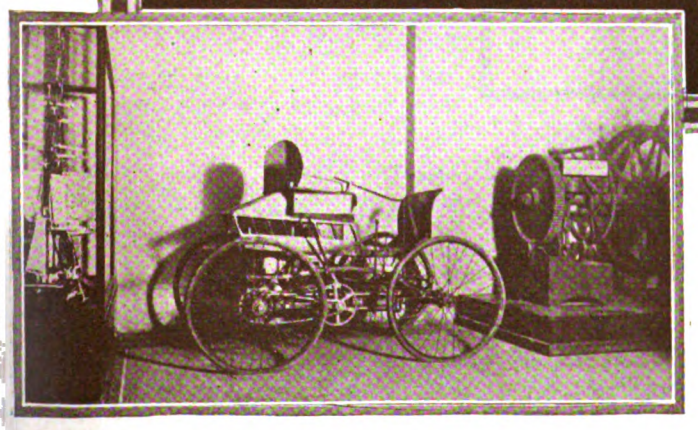


Ellwood Haynes, hale and hearty at sixty-five, is a splendid example of the strenuous, creative American. Beside his achievement in producing the first practical automobile, Mr. Haynes has many inventions to his credit, as outlined in the accompanying article.

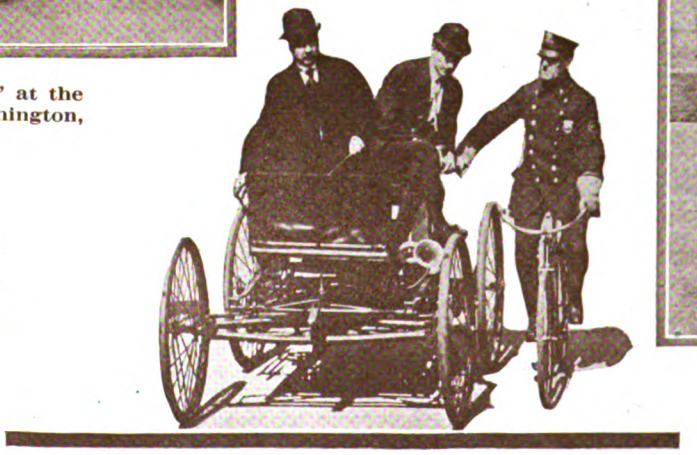
IF Dr. Russell H. Conwell ever delivered his famous lecture "Acres of Diamonds" to an audience in which Elwood Haynes sat, he talked to one listener who probably would be interested in what he was saying, but who did not need the lesson he put so graphically into that remarkable discourse. Elwood Haynes has found a lifetime of opportunity, activity, success and fame within sixty miles of his birthplace, and in the line of work which first attracted him as a boy of fourteen. No skipping about for him, no roaming far afield, either in person or in fancy. He has moved just once, from Portland, Indiana, which was his "old home town," to his new home town of Kokomo, also in the state of Indiana. If Portland had had a college, probably he wouldn't have gone away to college. As it was, he came straight back home, as soon as the Eastern institutions would let him go, with his graduate and post-graduate sheepskins and degrees, first to be principal of the home high school, and then to teach science in the normal school.

But he is the sort that would rather practice than preach, rather do than teach. When he was only fourteen he got hold of his older sister's textbook on chemistry, and

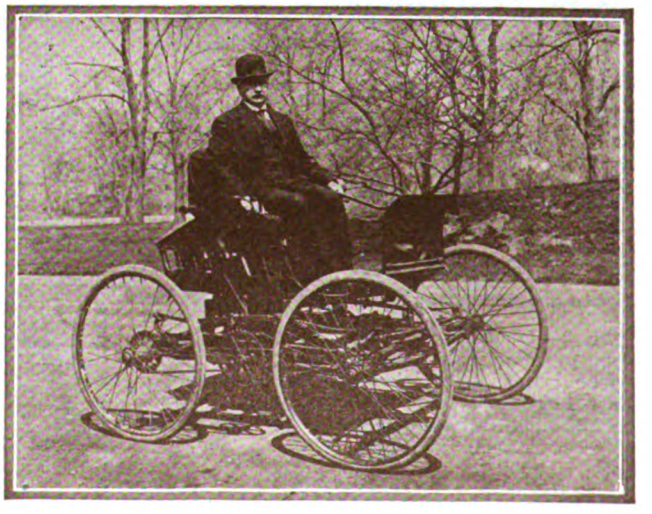
(*Continued on Page 66*)



The original "horseless carriage," at the Smithsonian Institute, Washington, D. C.



Driving to Chicago in his 1895 model, to enter the Times-Herald race, Mr. Haynes was ordered off Michigan Boulevard by a policeman—and there were no motorcycle police in those days.



The inventor and builder "at the tiller" of America's first automobile, which is now exhibit number 262,135 at the Smithsonian Institute.

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Handling Coal and Ashes on the Pivoted Bucket Carrier

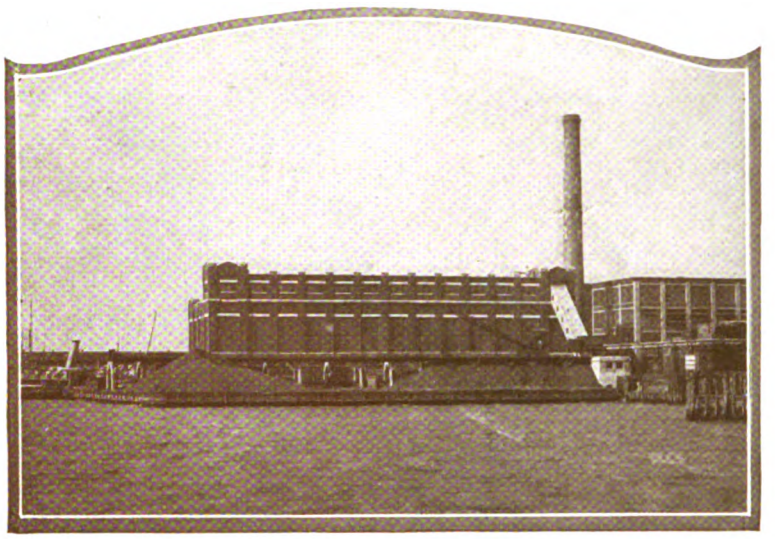
By C. H. McL. Burns

OUR very industrial supremacy seems to be ample proof that the immediate reduction in costs is not the only benefit to be secured from mechanical equipment, but that the less of a drudge a man is, the more intelligent, efficient and contented he becomes.

Nowhere is this truer, and the indirect saving more noticeable, than in the boiler room of a power plant. In the antiquated boiler room, with hand stoking, cleaning fires, quenching hot ashes in a cloud of steam and dust, and wheeling them out, a fireman can be nothing but a drudge. In the first place it is practically impossible to get a good fireman to work under these conditions, and in the second place he has not the time to give his fire the proper attention. On the other hand, a modern and well equipped boiler house, attracting as it does the best class of men, leaves a fireman free to concentrate his efforts on the feed of the stokers, the draft, and the proper condition of his fires for efficient steaming.

With modern mechanical equipment for handling coal and ashes it is quite possible to increase the boiler efficiency ten per cent or more; which means a saving of about fifteen per cent in the amount of fuel used. This in itself is a very considerable item, without taking into account the expense saved in the actual handling of coal and ashes.

Coal is still our greatest source of energy in the industrial world, and the problem of its economical handling or transporation, ever increasing with its importance and consumption, is just as big today as it was to Stevenson and his fellows at the dawn of the last century. However, it is receiving a great deal of attention at the present time; the high cost of labor and the general trend toward efficiency and economy in industry, demand the mechanical handling of all materials. Without mechanical means of transportation—conveying and elevating—all of our important industries would be impossible under present economic conditions, yet it is not more than twenty-five or thirty years since the manufacture of conveying and elevating machinery as we



Plant of the Victor Talking Machine Co., at Camden, N. J., showing the coal handling installation.

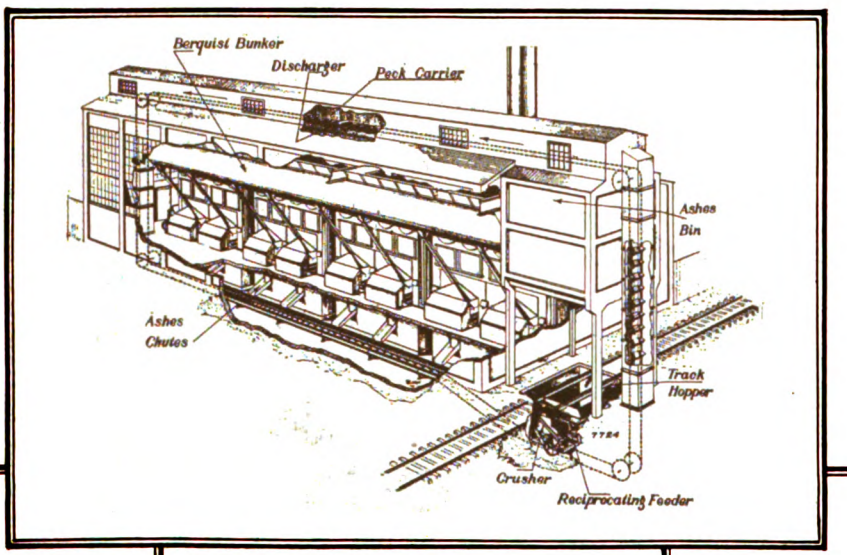


Fig. 2—Sketch showing a typical installation: the coal being carried from crusher below the track hopper, distributed over the length of the overhead bin, and spouted by gravity to automatic stokers.

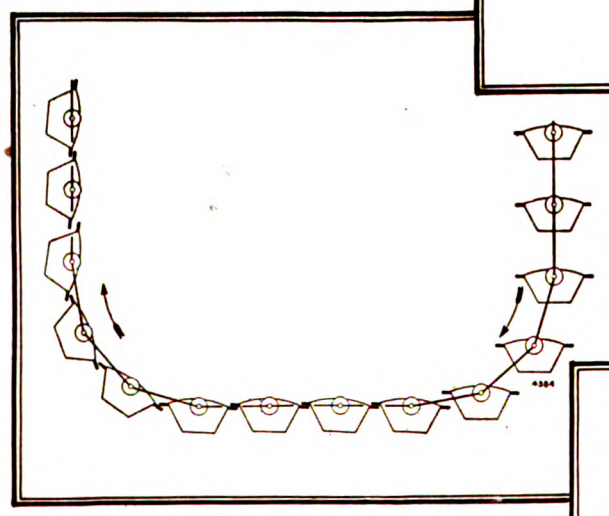


Fig. 3—Overlapping "lips" on the buckets prevent coal from dropping between; but, as shown above, the overlap introduces a complication: in ascending, the buckets would spill their contents.

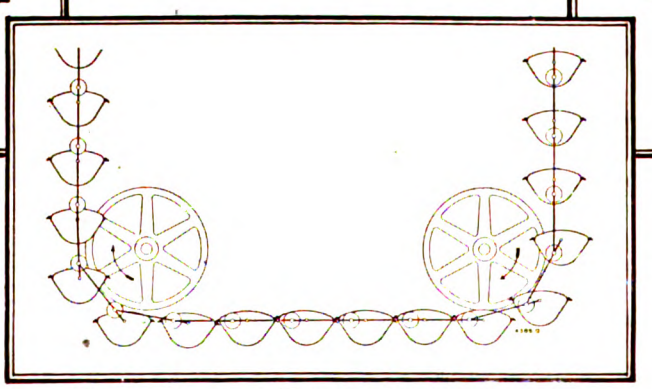


Fig. 5—By suspending the buckets from extension links, they travel a wider circle than the chain, thus overcoming in another way the difficulty shown in Fig. 3.

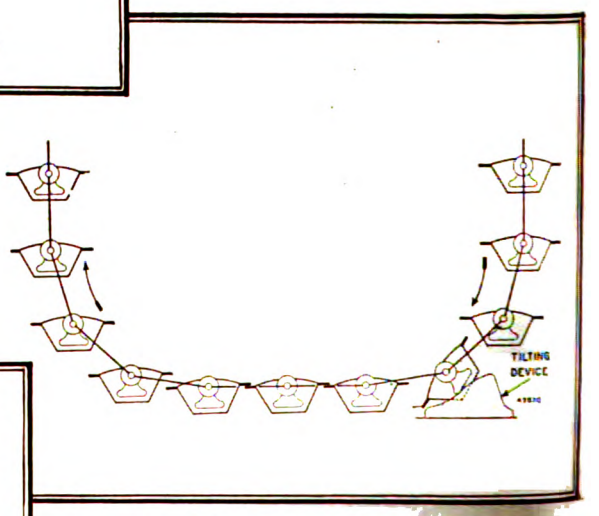


Fig. 4—Here, a tilting device reverses the overlap of the edges, so that the ascending buckets are not held down by the edge on ascending.

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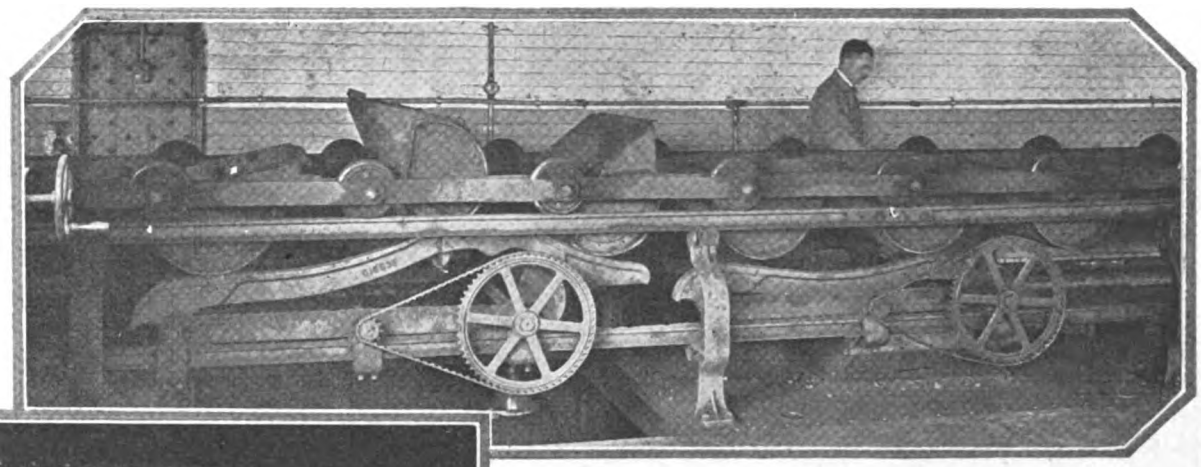


Fig. 6—A simple device which tips the buckets just enough to discharge their load, which can be either fixed or movable to any position on the horizontal run.



Fig. 8—View on the bucket run above the boiler house overhead bins.

know it today became general. Some of the leading manufactures of such equipment in this country at the present time were pioneers in the business nearly half a century ago, and the result of these years of experience, research and experimental work, has developed, especially in boiler house equipment, a product unsurpassed in the design of its mechanical details, and in efficiency.

In designing a storage and handling system for coal and ashes, in connection with a power plant, many factors have to be considered, and, unless the engineer has had considerable experience in this kind of work, many very important points are apt to be overlooked, and the result will

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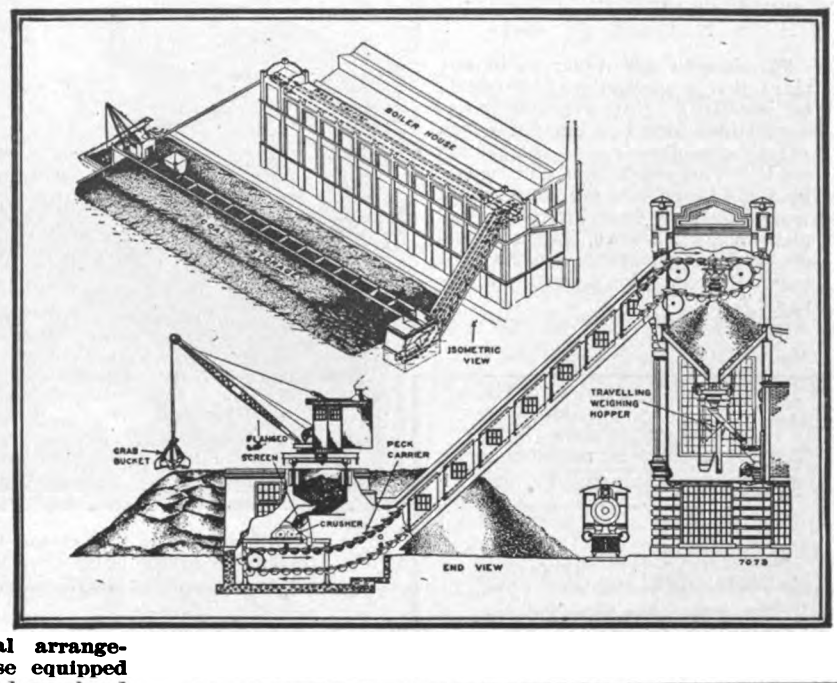


Fig. 7—Above—Typical arrangement of a boiler house equipped with bucket carrier and overhead bin. This gives an idea of the details of the installation pictured at the head of this article.

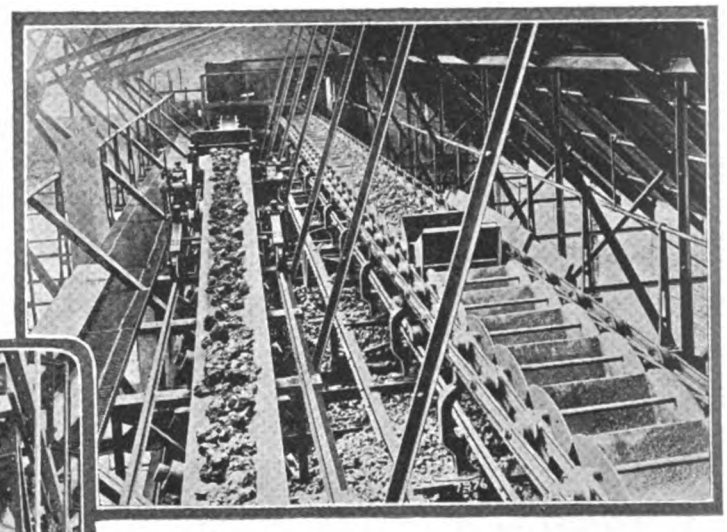


Fig. 9—Note the buckets at the right center (illustration above) in the act of dumping their contents to storage.

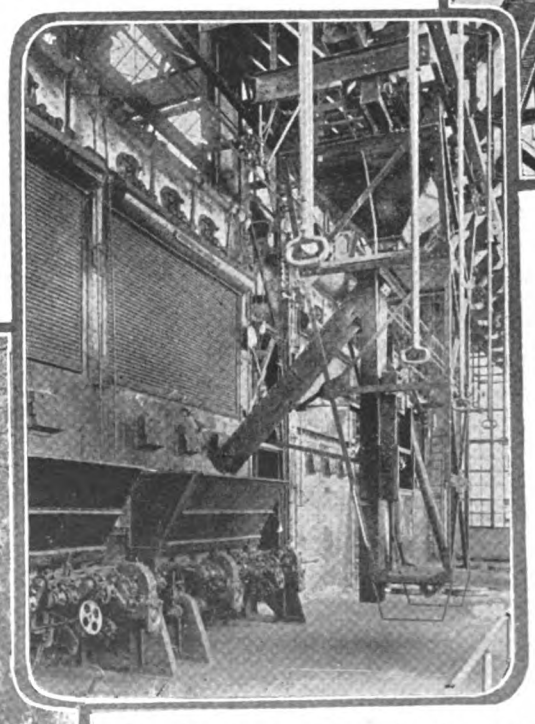


Fig. 10—At the left—spouts which deliver by gravity from overhead bins to automatic stokers.

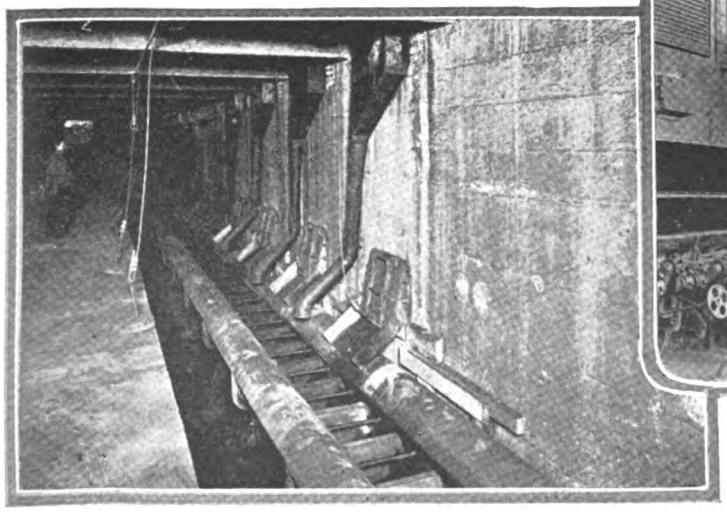


Fig. 11—At the left—ash chutes deliver ashes direct to bucket carrier for transport to final removal point.

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Five Essentials of a Suggestion System

By George Gray

A SERVICE organization which had been installing some welfare features in a factory in the South received this letter from one of the employees:

> "Could you get it across in our plant that a suggestion box system be installed? Not one that buries suggestions in a box but one which must consider every suggestion made. The production club would be a good jury. At the same time it would be kept lively. As a small plant in a small town, jealousies and personal considerations run riot here. Please don't mention my name."

There are two important items of information in this letter. One is the evidence of employee interest. The other is the evidence of employee suspicion and distrust. This man wanted an opportunity to submit suggestions, but he had had experience in another factory with the wrong kind of suggestion system. Hence his warning against a scheme that "buries suggestions in a box" and his concern for the securing of "a good jury." Many a suggestion system that was started on the crest of a wave of goodwill has gone down in a fog of indifference and suspicion, and the rock that

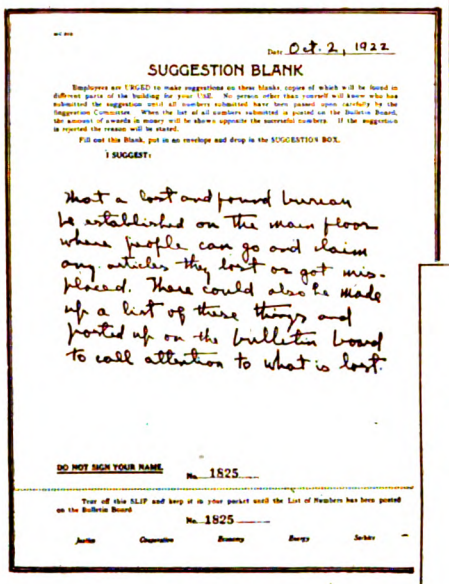
(*Continued on Page 36*)



Members of the Suggestion Committee, National Cash Register Co., who select the prize winners and decide questions of policy.



These employees devote their whole time to the suggestion system, handling the clerical work, at the National Cash Register Co.



Date Oct. 2, 1922

SUGGESTION BLANK

Employees are URGED to make suggestions on these blanks, copies of which will be found in different parts of the building for your USE. No person, other than yourself will know who has submitted the suggestion until all numbers submitted have been passed upon carefully by the Suggestion Committee. When the list of all numbers submitted is posted on the Bulletin Board, the amount of awards in money will be shown opposite the successful numbers. If the suggestion is rejected the reason will be stated.

Fill out this Blank, put in an envelope and drop in the SUGGESTION BOX.

I SUGGEST:

that a lost and found bureau be established on the main floor where people can go and claim any articles they lost or got misplaced. There could also be made up a list of these things and posted up on the bulletin board to call attention to what is lost.

DO NOT SIGN YOUR NAME. No. 1825

Tear off this SLIP and keep it in your pocket until the List of Numbers has been posted on the Bulletin Board

No. 1825

Note, above, the method of keeping the suggester's identity secret until decision is made.

On Guard!

Do you work on a machine?
Is the machine properly guarded?

In making a Safety Suggestion, the important question is:

"Can an accident occur?"
NOT:
"Has an accident occurred?"

One man's effort toward Safety may be small; 13,000 of us, working together, can accomplish much.

One think BEFORE an Accident is Worth a Million Thinks Afterwards!

Eastman Kodak Company

At the right—a tie-up between the Safety idea and the Suggestion System.



This certificate and a medal go to successful suggesters at one large plant.

$2000 for suggestions First Six Months, 1922

THINK — SUGGEST

$2,000
Cash Prizes for 171 Employees
$1,000 will be added to the above if the suggestions warrant the addition. If this addition is made it will be pro-rated among the more valuable suggestions.
Regular six-months suggestion contest ending June 30, 1922.

Rules	Nature of Suggestion	How Handled	Prizes	How Prize List is Made Up
All employees, except pyramid heads, superintendents, departmental heads, foremen, job foremen, section heads, and sales agents, may compete. Address suggestions to Suggestion Department, Building No. 10. Suggestions pertaining to maintenance repairs, such as carpenter and millwright, electrical, millwright, and plumbing work will not be considered as suggestions unless accompanied by an improved method of doing the work. For example, replacing window glass, repairing light wires, or fixing leaky steam pipes, etc. Suggestions made by an employee affecting his or her work and where it is within their own province to make the change or improvement and is their duty to improve, will not be considered for a prize; however, if the suggested change has to be authorized by a superior, it will be considered as a suggestion and the suggester entitled to prize consideration if adopted. Any suggestion rejected one year before the beginning of a contest, will not be considered for a prize unless resubmitted. If a suggestion is resubmitted and because of changed conditions, is adopted, credit will be given to the one who re-submits the idea. Write clearly and describe the idea so that it can be readily understood. Date and sign all suggestions. Sketches should be on separate sheets, attached to suggestions. Any employee who desires further information or help in writing up their ideas may obtain same by writing or calling the Suggestion Department. Credit will be given for a suggestion which has value but which cannot be adopted because it cannot be used at the present time.	1. Suggestions are desired on all subjects pertaining to the business, namely: (a) Increasing co-operation. (b) Improving the quality of our work. (c) Decreasing the cost without decreasing the daily wage and lowering the quality. (d) Eliminating unnecessary and duplicating work. (e) Better plans for shop work. (f) Increasing the sales of our product. (g) Improving blank forms. (h) Improving the health of our employees. (i) Additional safety precautions to make the work less dangerous. (j) Using cheaper tools and operations to accomplish the same results. 2. Complaints are also desired. (a) A complaint that leads to an improvement receives the same credit as an adopted suggestion.	1. Each suggestion is read and classified according to the subject with which it deals. (a) Acknowledged, entered upon the employee's record card, and copied without signature. (b) Sent to proper pyramid head for investigation. (c) The name of the suggester will not be given out until his or her permission has been secured. 2. After investigation, a report is received as to the merits of each suggestion. (a) If a suggestion is not adopted, reasons are given. (b) If adopted, the suggestion is put into effect as soon as practicable. 3. In each case the employee is notified whether his suggestion is adopted or not, and if not, why. 4. Sometimes employees ask that a reinvestigation of their ideas be made. We are always glad to do this. 5. Complaints are handled by some member of the Suggestion Department personally.	The employee having the best adopted suggestion or suggestions will receive $100 cash. The two employees having the next best adopted suggestions will receive $75 each. The four employees having the next best adopted suggestions will receive $50 each. The six employees having the next best adopted suggestions will receive $35 each. The 10 employees having the next best adopted suggestions will receive $25 each. The 15 employees having the next best adopted suggestions will receive $20 each. The 25 employees having the next best adopted suggestions will receive $10 each. The 108 employees having the next best adopted suggestions will receive $5 each.	All the adopted suggestions submitted by an employee are considered together in awarding prizes, so that one might submit a number of minor suggestions and still win a big prize. The following comprise the committee which awards prizes: Wm. Hartmann, S. C. Allyn, D. R. Hall, A. A. Kelser, A. J. Kiley, J. W. Dunne, C. E. Stines, H. B. Scott, E. E. Barnes, R. O. Bloom. The committee studies the adopted suggestions very carefully, and places a valuation on each one. Then the suggestions are classified and the prizes are awarded accordingly.

Five Points Considered in Awarding the Banner: 1. Total Prize Money. 2. Number of Prize Winners. 3. Number of Adopted Suggestions. 4. Average Prize Money per Adopted Suggestions. 5. Average Prize Money per Employee in Department.

This National Cash Register Co. poster is both an announcement and a general outline of the rules governing its Suggestion System.

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Weighing Materials "On the Move"

Some of the Things Made Possible by Conveyor Weighing

AS industry has more and more, become converted to scientific methods, the matter of accuracy in weights—of raw materials, coal, and so on—has assumed a growing importance. But, coincident with the need for accurate weighing, has grown the demand for speed in moving these materials to and through the plant; and speed and accuracy are two factors so opposite in characteristics that they are difficult to reconcile.

With the development of conveyors—belt, bucket, or pan—the question of speedy and laborless transport of bulk materials was solved. But, until a few years ago, no matter how fast these materials could be transported, if an accurate check on their weight was required there had to be a pause in the steady flow somewhere along the line to permit of weighing.

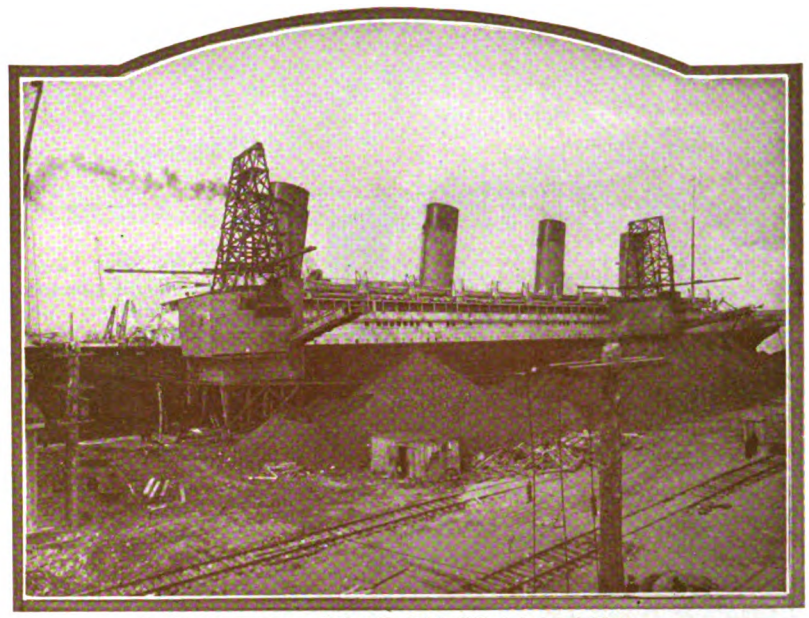
It is a comparatively simple matter, to measure the volume of a gas or liquid passing through a pipe. But measuring the *weight* of bulk material in motion on a conveyor, involves entirely different principles; yet by an ingenious system of suspension and gearing, even this has been accomplished. A portion of the conveyor is suspended on a floating platform hung from a load lever system similar to a platform scale. The load on this suspended portion is counterbalanced by a steel float in a mercury bath supended from the long end of the weighing beam. This float allows the beam to move from its zero position (the position when no material is on the conveyor) in exact proportion to the weight of material on the suspended portion of the conveyor at any given moment. At the same time, by gearing from the conveyor itself, a mechanical integrator transmits this beam motion to the actual weight indicator, in proportion to the speed of travel: so that, with the conveyor at rest, though loaded, the indicator registers no weight passing; if the conveyor is operating at full speed, but empty, the indicator still remains at zero; while for all conditions of speed and load the two integral factors produce an accurate indicator reading.

Not only in loading in and out, but in many manufacturing operations this method of weighing eliminates a man at the scale and results in better organization of production processes.

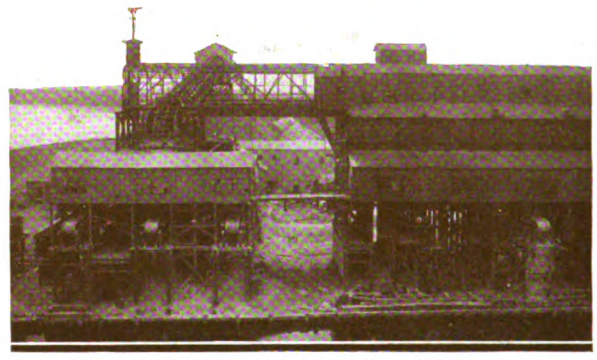
For example, at the coaling station of the British Ministry of Shipping, Halifax, N. S. the coal is drawn from the storage pile by grab buckets, which discharge upon a belt conveyor, is passed to the hold of the vessel; being weighed on this conveyor. Thus an automatic, accurate check is kept on the amount of coal loaded.

At the plant of the Milwaukee Coke & Gas Co., Milwaukee, Wis., as at many other plants, the coal is discharged from the cars to a belt convey-

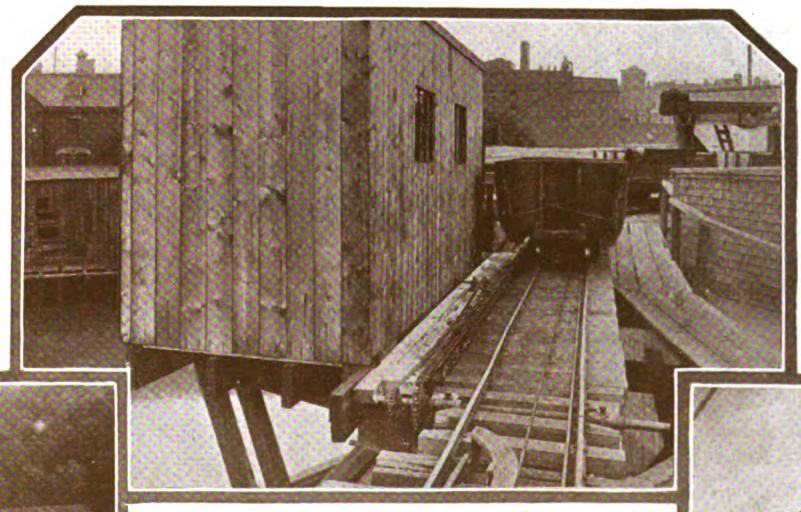
(*Continued on Page 50*)



Coaling station of the British Ministry of Shipping, Halifax, Nova Scotia, Canada. The coal is drawn from the coal pile by means of grab buckets, deposited on the conveyors which run through the scale house, and discharged to the ships' bunkers.



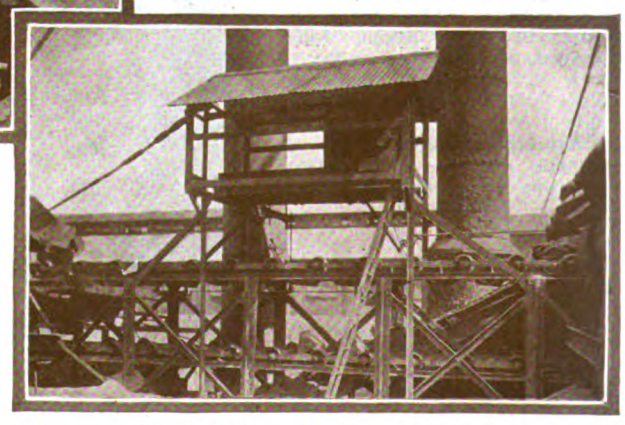
Plant of Michigan Limestone & Chemical Co., Rogers, Mich.—Five to six millions of tons of stone yearly are weighed and billed over conveyors. Views show loading conveyors discharging to barges



Cable car approaching track scale. Here the weight is automatically recorded while the car is in motion.



Typical Coal Mine tipple. The conveyor scale is placed in this pent house shown on the long conveyor and weighs the coal as it comes from the mine crushers.



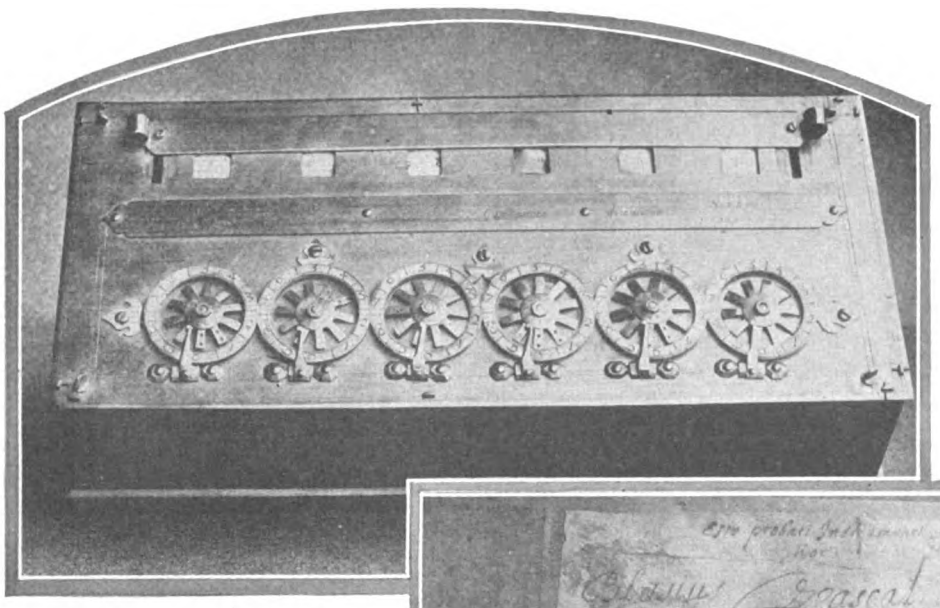
Typical installation of a conveyor scale installed on a bucket conveyor handling hot cement clinker. The weight of the material is mechanically recorded.

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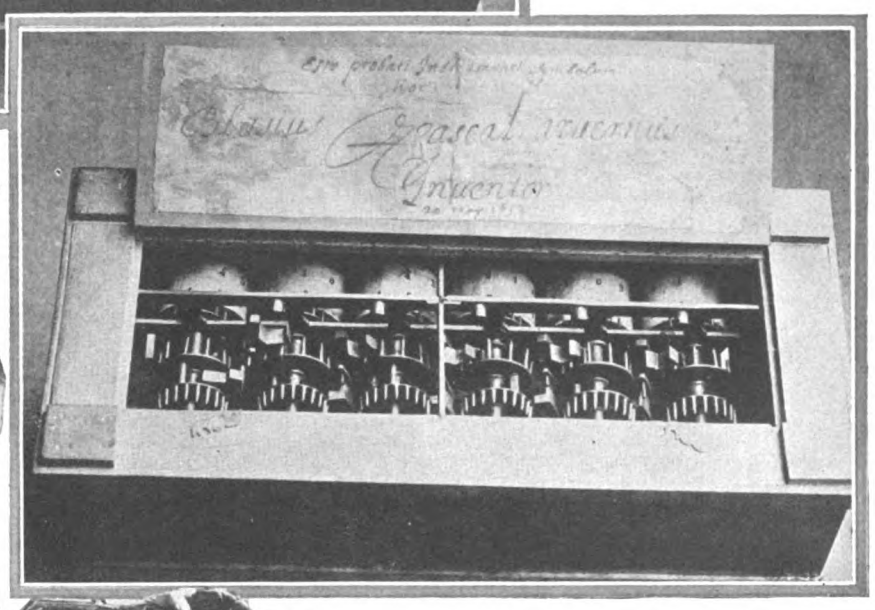
Getting Figures that Can Not Lie

The Evolution of the Adding Machine

By Ernest H. Rowe



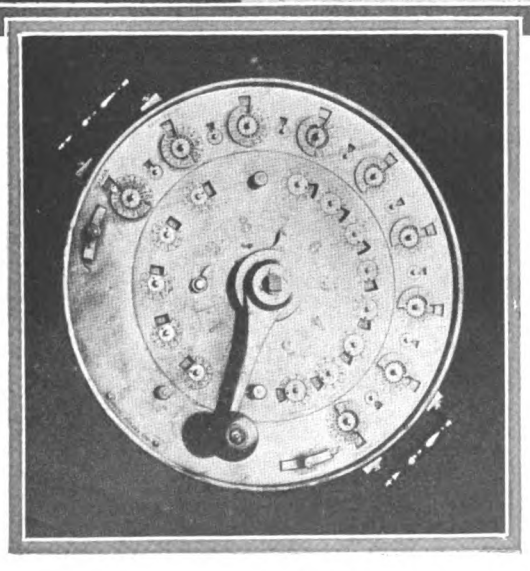
Pascal's, the first automatic calculating machine known, fortunately preserved in the Paris Museum of Arts and Trades. Designed to figure English money Its principles are extant in modern machines. Top front view.



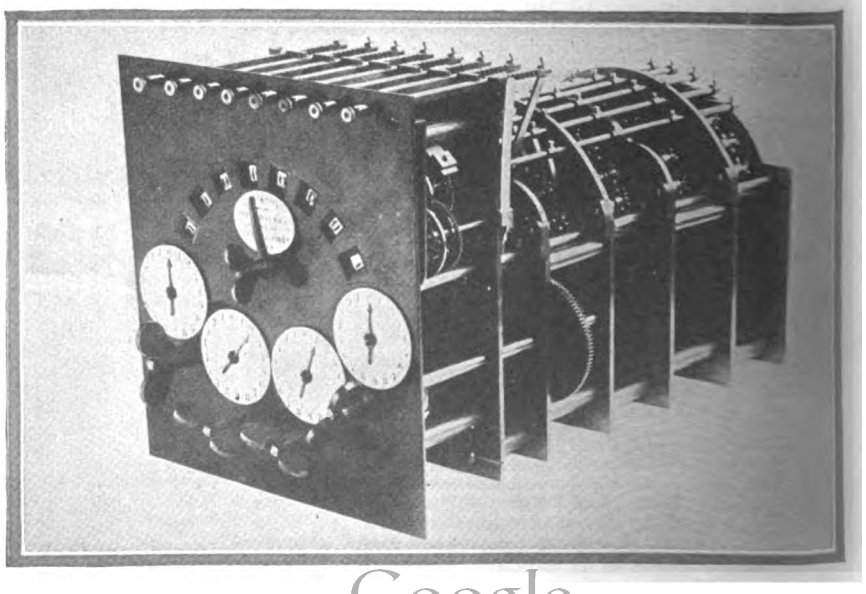
Bottom view of Pascal's machine. Inscription: "Esto probate instrumenti symbolum hoc Blasius Pascal arvernus Inventor. 20 May, 1652." Translation: "May this signature be the mark of an instrument approved and invented by Blaise Pascal. May 20, 1652."



The first all-around successful calculating machine. Thomas' Arithmometre, invented about 1820. Improved, it is in use today.



Roth's calculator, about 1841. A Pascal type machine, but unsuccessful from the practical standpoint.

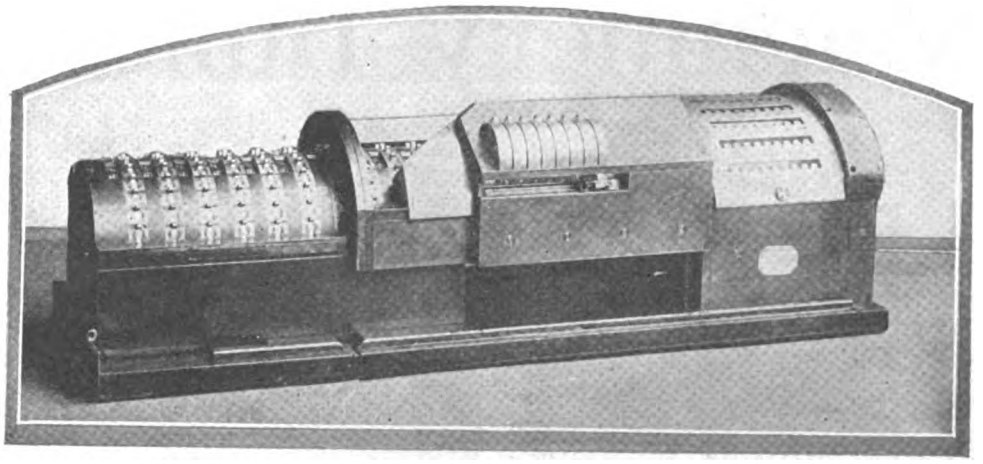


Maurel and Jayet's (1847) machine in the Paris Museum of Arts and Trades. Another attempt to apply the Pascal method.

In tracing the history and development of any of our modern labor-saving devices, from the highly complicated typesetting machine to the comparatively simple revolution counter, it is interesting and significant that one fact is common to almost all of them: no matter how ancient or how recent the first attempts may be, the greatest strides in perfecting these new machines were made after man had harnessed steam to do his bidding. That, of course, brought into being the epoch of factory production, assembling many workers under one roof. This emphasized the time element in production, exposed the aggregate time losses made up of small units of loss that were invisible or negligible under the cottage system of production, and made it worth while and feasible to apply methods and devise machines to save them.

Naturally enough, such appliances were made and used for shop practice long before any were devised for office use. It was hardly thought that the mental operations of accounting and recording could be made mechanical. While the first actual adding machine was designed for figuring English money, it was more than two hundred years before another machine for the practical pur-

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The Russian mathematician, Tchebycher (1871), endeavored to combine the principles of the Pascal and Thomas machines.

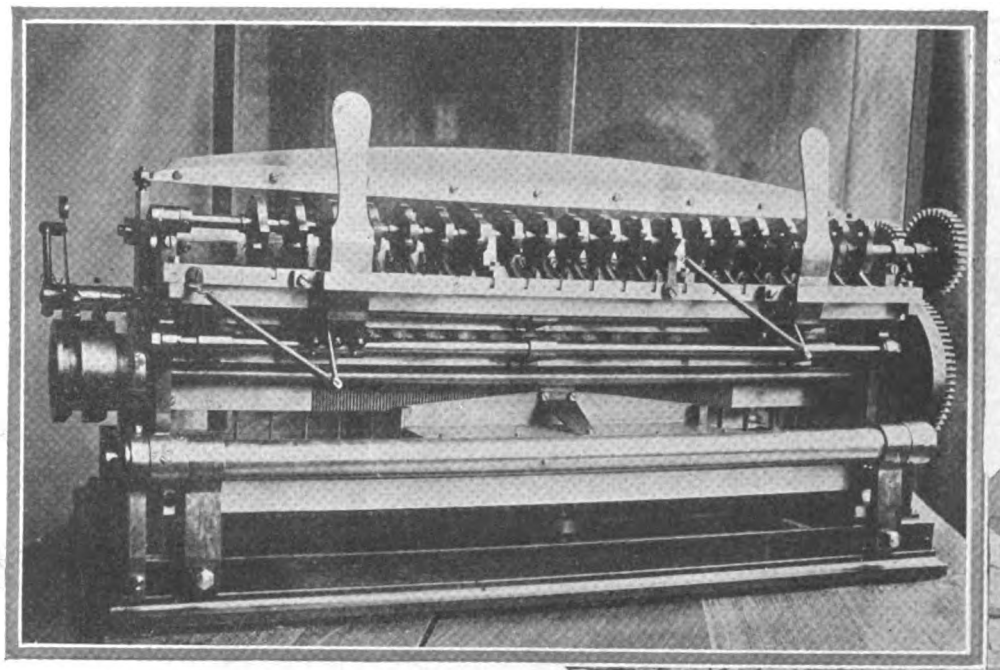
He carried the art forward a step, but without arriving at the goal of practical success.

poses of accounting was produced. This first machine was invented by the French Savant, Blaise Pascal, in 1652, when he was but nineteen years of age. It is now in the Paris Museum of Arts and Trades and is shown in the first two illustrations of this article. It will be apparent that the discs must be turned by hand. Many machines are mere refinements of the Pascal model without improving on that feature, although many inventors endeavored to eliminate it, but without success for a long time.

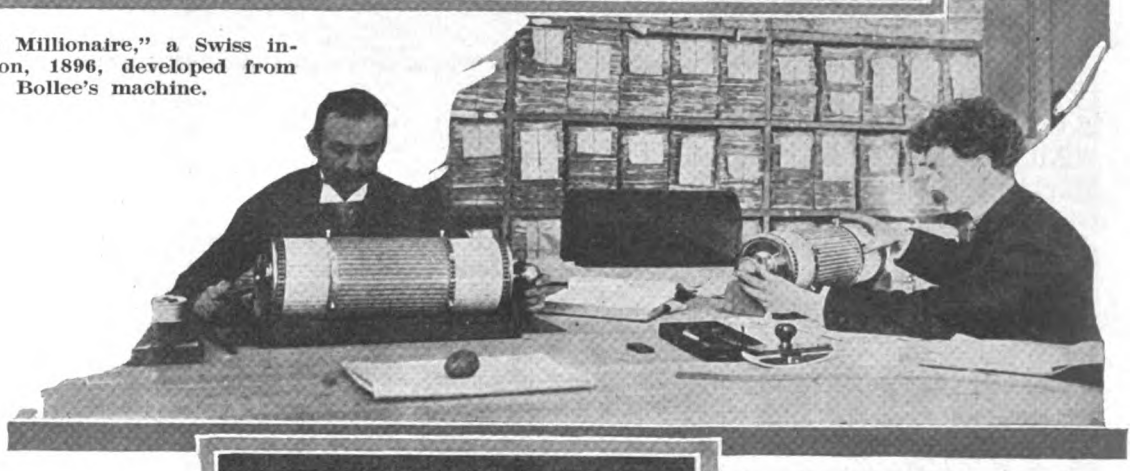
European development pursued the idea of a machine that would perform a variety of mathematical calculations, for the use of scientists; while in America, the land of big business, the inventors, when they began to work about the middle of the nineteenth century, undertook to produce an adding machine to speed up and improve the bugbear of bookkeeping. The great Russian mathematician Beidnitz created a marvel in 1694, which is still in existence, but which imperfectly performed its intended task of assisting astronomers and others who had tedious and abstruse problems to work out.

(*Continued on page 32*)

The third stride forward in the art of mechanical mathematics. Bollee's machine, 1896, definitely foreshadowed the modern apliance, indispensable to business, economics and science.

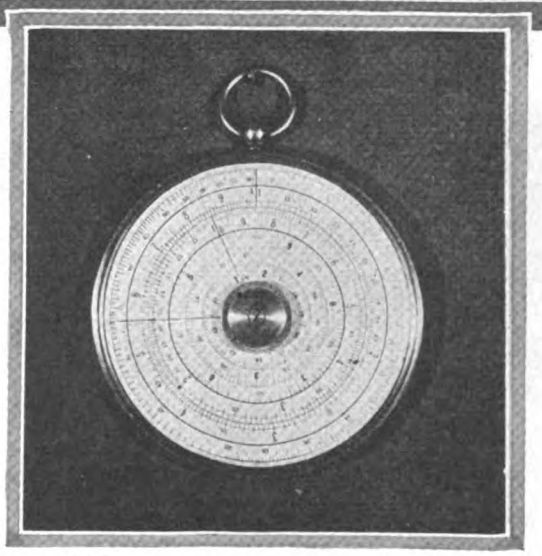


"The Millionaire," a Swiss invention, 1896, developed from Bollee's machine.





Halden's pocket calculator, invented 1906, is useful to many men whose observations and notes, made in the field, are rendered more accurate in themselves and less liable to errors in transcription by draftsmen when they are enabled to send in the initial calculations all worked out, rather than rough notes, sketches and figures, often illegible, and with no opportunity to check chance errors on the ground.



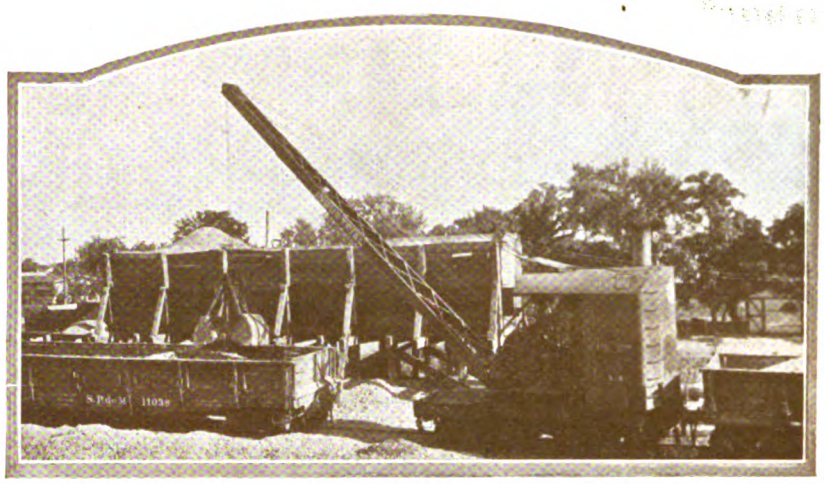
One of the many modern adding and calculating machines which juggle figures as few people can. With transactions nowadays of such magnitude that they commonly run into ten and twelve figures, and with margins of profit and loss so narrow that accuracy must run into several decimal places, 20th century business could not exist without this mechanical brain.

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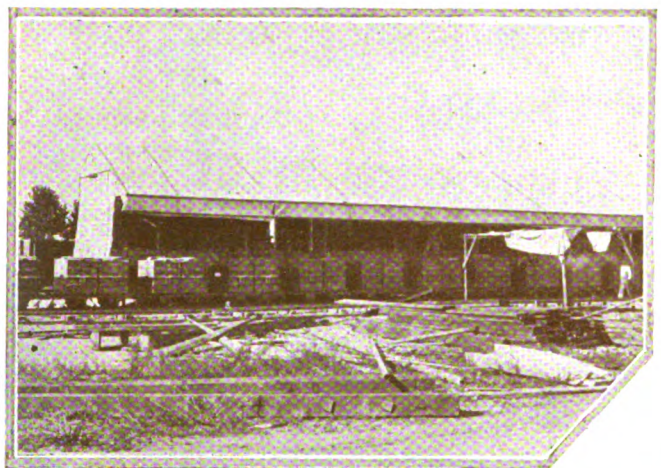
How Machinery Builds Roads

THE accompanying photographs show some interesting details of the largest concrete road-building project ever attempted by one contractor as one job. The work is being done by Twohy Brothers of Seattle, Washington, and Phoenix, Arizona. This year they will complete 187 miles of concrete highway 16 feet wide and 5 and 8 inches thick. Last year they completed a contract for 130 miles in the same county.

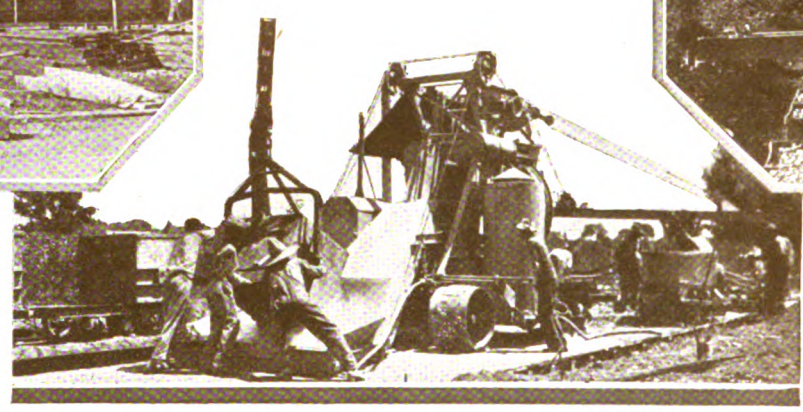
All of these roads are in Maricopa County, Arizona, of which the city of Phoenix is the county seat. It is the most densely populated county in the State of Arizona. When the project is completed, no farmer in the general vicinity of this network of highways will be more than one mile from a concrete road.



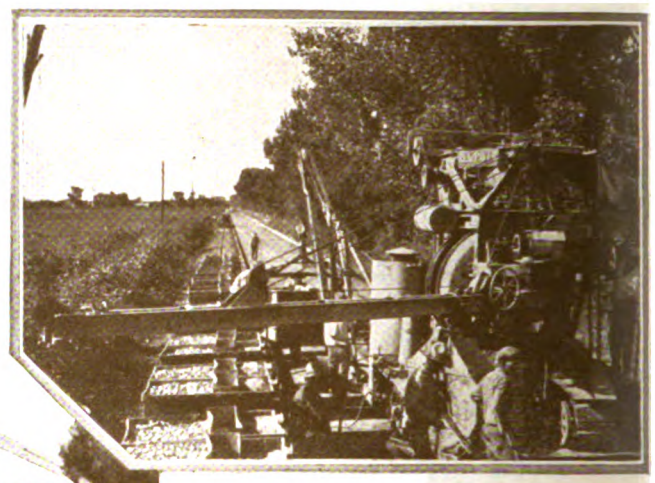
Gravel is brought by rail from the bed of the Salt River and transferred by crane to proportioning bins. From these bins, the materials are spouted to batch boxes mounted on industrial cars and then conveyed to the jot.



Here are the batch boxes mounted on industrial cars passing the cement shed. Four bags of cement are dumped into each batch box, or just enough for one complete batch in the concrete mixer.



The boxes are then transferred by means of a derrick attached to the paver, to the charging skip, each box containing a proper proportion of sand, gravel and cement for a complete batch.



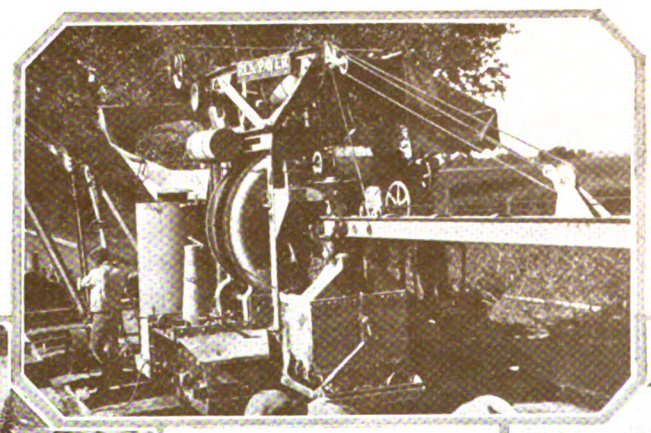
Arrival of the batch boxes at the paver.

When one considers that many paving contractors do only ten to twenty miles of concrete paving in a season, it gives some idea of the extent of the work being done in Maricopa County.

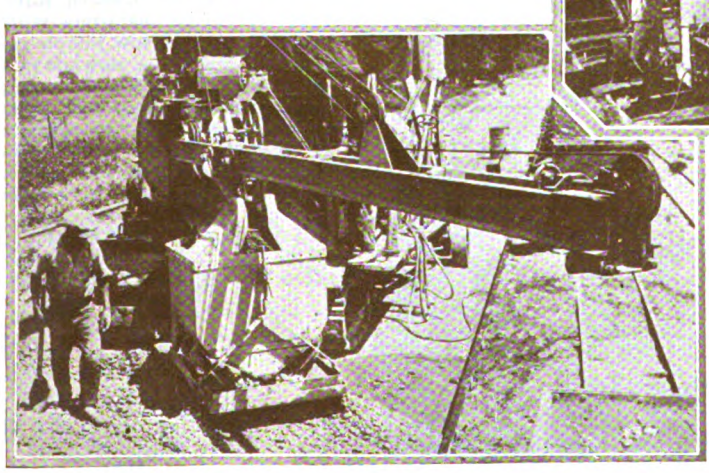
Not the least interesting thing about the job is the speed at which the work is being handled. As high as 114 lineal feet of highway have been laid in one hour, using what contractors know as four-bag batch of 1-2-4 mix. This means that for every one bag of cement, there are two cubic feet of sand and four cubic feet of gravel.

Four times this quantity is put into the paver for each batch of concrete. The specifications of the highway department in the State of Arizona call for a mixing period of one full miute for each batch of concrete. The contractors

(Continued on page 30)



After the materials have been dumped into the skip, the skip is raised and the materials pass into the drum. When properly mixed, they are discharged from the drum into the distributing bucket, which is shown in the foreground of this picture. You will note that the drum is discharging into the bucket during the period when the skip is being raised. This accounts for the great speed at which the concrete highways in Maricopa County are being laid.

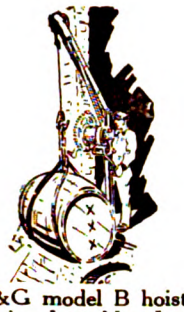


When the bucket has dropped its load of concrete on the subgrade, it returns to the machine at the same time spreading the concrete by means of the spreader attachment which is seen in the foreground. This spreader saves both time and labor.

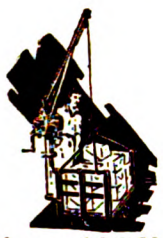


A general view of one of the jobs from the finishing end. In the foreground may be seen some of the finished concrete over which the tamping machine has just passed.

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A G&G model B hoist is in use in a large New Jersey Chemical Plant for handling bales and drums between the second floor of warehouse and freight loading platform in yard below. Note that Hoisting Head revolves so that load may be easily deposited on floor inside building.



Another model B Hoist is in use in a Western paper box factory for handling loads between floors. Note that loaded floor truck is picked up bodily. G&G brake device permits absolute control while lowering by gravity.



A Brooklyn, New York, machine tool factory used a model D G&G Hoist for removing ashes from cellar directly into truck without rehandling at grade. This Hoist operated by electric power, and tests show it raises and lowers 78 cans in one k.w.h. hour.



This model E G&G Electric Hoist is in use in Washington, D. C., for raising bales of paper, and so forth, from cellar to sidewalk level. The model E Hoist is extremely economical in the consumption of current. A recent test at an installation in a New York Telephone Company building shows that 15½ tons of ashes can be raised in one k.w.h. costing the user about 3½ cents.



Your Factory Needs This Hoist

THE G&G Hoist above illustrated is one of the four in use at the Packard Motor Car Company's plant in Detroit. In this instance core sand is being raised a height of one floor, but there are many other uses for this Hoist, such as the handling of boxes, bales, barrels, floor trucks, etc.

Note the ease with which *one man* can do the work with this Hoist. But little pressure is required on the Hoist Handle to raise the average light factory load *by hand*.

It is significant that the Packard plant found the first two G&G Hoists installed so satisfactory that two additional hoists were ordered without solicitation.

The hoist problem differs in practically every factory. Therefore G&G Hoists are made in a variety of styles to meet every need.

If you will tell us what loads you are handling, our Engineering Department will be glad to recommend the model best suited to your individual requirements.



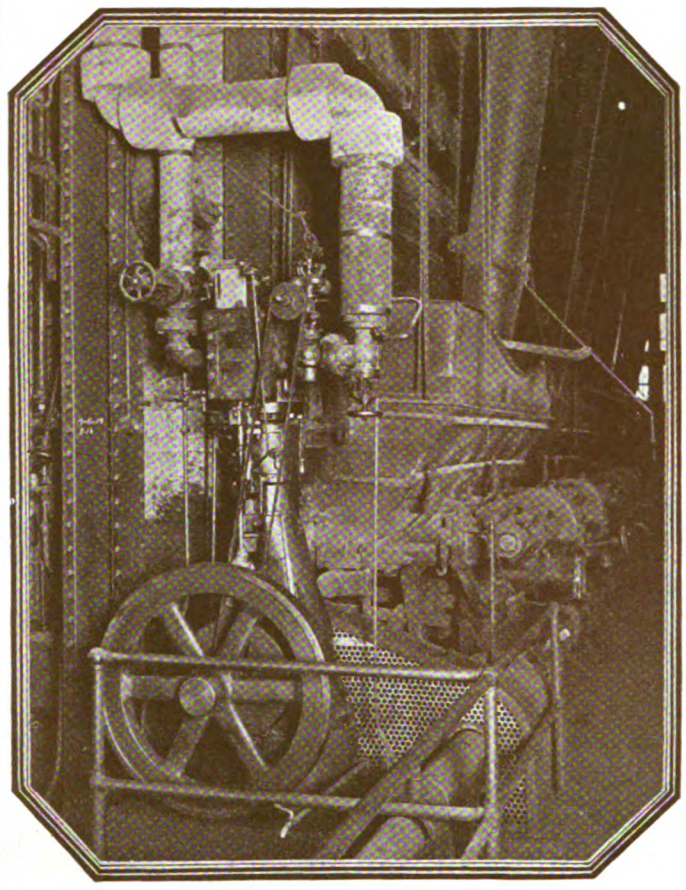
Write for free booklet "Industrial Plants Need This Hoist."

GILLIS & GEOGHEGAN, 556 West Broadway, New York

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TROY ENGINES

ONLY STEAM ENGINES GOOD ENGINES ONLY



One of the two Troy Engines installed at the Livingston Power Plant of the Richmond Light and Railroad Co., Staten Island, N. Y.

Each engine drives the stokers of 10 boilers.

Twenty months continuous duty and good for years to come

Two 30 H.P., 8" x 8" Throttling Self Oiling Troy Engines were installed at the Livingston Power Plant in May 1921.

They have been giving continuous dependable service—responding to every excess demand of peak load conditions and have required almost no attention.

The Self oiling system, the balanced valves, absolutely leakless and practically indistructible, the rugged design—these and other exclusive Troy features make Troy Engines the national choice where small engines are required.

Write for the Troy Catalog

TROY ENGINE & MACHINE CO.,

TROY, PENNSYLVANIA

Handling Coal and Ashes on the Pivoted Bucket Carrier

(*Continued from Page 21*)

not be as satisfactory as desired. This is not only true of the general arrangement but also of the details of the equipment, for probably in no class of conveying and elevating machinery is the design and construction of details of more importance. Machinery here is subjected to unusual conditions of wear and corrosion, and two equipments very similar in appearance may give very different results in actual operation, a great deal depending on small details in design and construction. The economical operation of the plant will therefore depend to a great extent on the integrity and experience of the engineers and manufacturers.

The storage problem is usually divided into two classes; the active storage, to take care of the more immediate needs, and usually consisting of overhead bunkers or bins of some type from which the coal is shot by gravity to the stokers; and a reserve storage large enough to eliminate any danger of suspended operation of the plant. The reserve storage is usually a rather variable problem, depending upon the amount of storage required and the space available.

For the solution of these problems there is quite a variety of efficient and economical equipment, each best suited to some special case, such as electrically operated buckets on mono-rail tracks, locomotive cranes, gantry cranes, power scoops, conveying equipment, etc.

But when it comes to the handling of the coal and ashes in the power house, we have a very different problem. In all but very rare cases the coal has to be elevated from the track hopper and crusher to the overhead bunkers, and then distributed along this bunker or bin; and the ashes must be collected from under each boiler, and conveyed and elevated to a storage bin over the railway siding, or to some other point of disposal. Where real economy and efficiency are desired, one type of equipment worth considering is the pivoted bucket carrier. It is elevator and conveyor in one, and is undoubtedly one of the highest developments in the art of mechanically handling material.

Figure 2 illustrates a typical installation where the coal is carried from the crusher below the track hopper, and distributed over the length of the overhead bin, from which it is spouted by gravity to the automatic stokers. When the overhead bin is filled, the gates of the ash hoppers under the boilers are opened, and the ashes discharged onto the lower strand of the carrier, by which it is conveyed and elevated to the ash storage bin over the railway siding. It will be noticed in the illustration that this particular carrier maintains the buckets in their carrying position, whether traveling horizontally or vertically, up or down and this is true of this particular type regardless of the path taken.

A pivoted-bucket carrier consists essentially of a continous series of buckets pivotally suspended between two specially designed endless chains. The outstanding advantages of this carrier are:

1. The material is carried, and the buckets are supported by rollers. Destructive friction and injury to the material itself is therefore eliminated, and the power required for operation reduced to the minimum.

2. The ability of the one machine to elevate and convey avoids transfers, which are always troublesome, take up valuable space and necessitate deep pits. The driving connections are also correspondingly simplified.

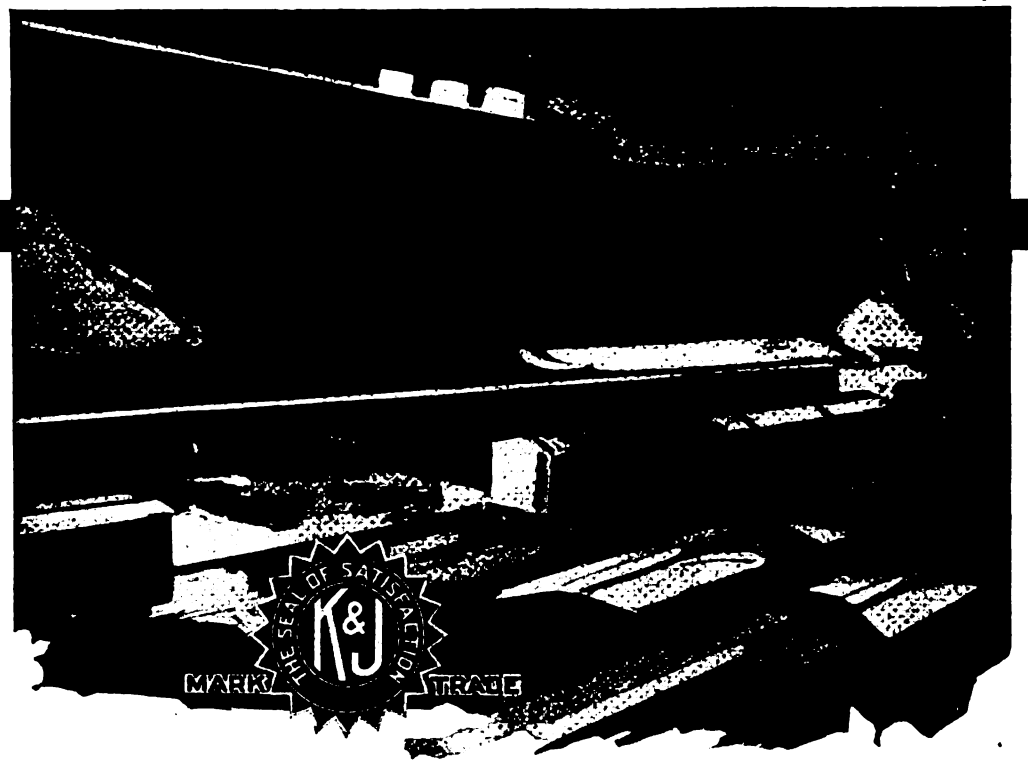
3. The material is readily discharged at any desired point.

4. Their operation is silent, and as they are run at slow speed there is no vibration.

Simple as the design of this carrier appears at first sight, it has had much thought and time expended on its development, by many of the foremost elevating and conveying engineers in the country. The earlier types merely had the buckets hung as close together as was practicable, to prevent material as delivered to them,

(*Continued on Page 30*)

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Write for Bulletin No. 510

Hyatt Roller Bearings are standard equipment on "K & J" Standard Trailers—

Freight House Costs Interest Everyone—

Practically all kinds of merchandise must go through the freight house or across the dock. If there's a waste in operating costs at these points all merchandise pays part of it.

Naturally all business is interested in the methods adopted at these important points. "K & J" Trailer Trains with tractor are being adopted widely for such use and their highly satisfactory results are plain for business executives to see.

You approve of the adoption of these modern systems at such points yet perhaps continue with the less modern methods yourself.

The savings you might make in your own plant by means of modern trailer-tractor systems is far greater than your pro-rata of freight house economies.

It is far more important to you, individually, to stop material-hauling wastes on your product in your own plant.

Let us tell you of the remarkable cost-cutting records that have been made with "K & J" Trailer Trains.

This is a plan drawing of "K & J" Standard Trailer, Type 122W.

Note the specialized principles of construction of this unit.

Note the two-point load support at each large wheel.

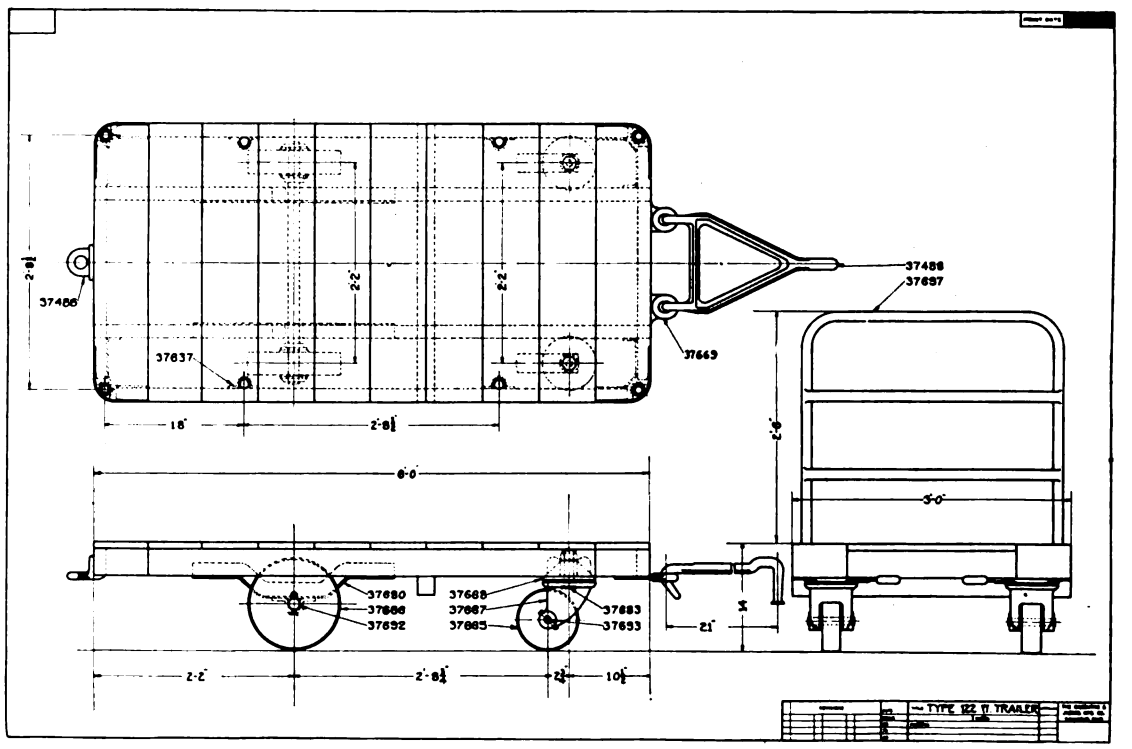
Four heavy, lengthwise beams or sills support platform.

Frame unit is rigidly tied by corner brackets secured to center sill as well as side sill.

Heavy caster unit of top plate type turning on wide ball race.

Wheels and caster jaws of semi-steel. Approx weight, 450 pounds.

"K & J" standard Trailers are made in many capacities. Special designs of all types are furnished.



The Kilbourne & Jacobs Mfg. Company, Columbus, Ohio, U. S. A.

NEW YORK OFFICES, 120 BROADWAY

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Tremendous heat has little effect. A fall, plus the crushing load of collapsing walls, is successfully withstood by Globe Structural Strength Safes.

There is not enough combustible material in any fireproof building to harm this safe. However any building, not fireproof, will collapse when subjected to intense heat for an hour. A safe, therefore, loaded heavily with records, must withstand a severe fall and the tremendous impact of crumbling walls and other heavy materials.

Globe

Structural Strength Safes

Have proven in every fire that they do possess the necessary inbuilt Structural Strength. In the recent disastrous fire in the Austin Bldg., Chicago, a Structural Strength safe fell six floors to the basement where it was completely buried by falling walls and heavy debris. Days later, when workmen dug it out, its contents were found to be safely intact. It is the Structural Strength plus the heat resisting qualities that enable Globe Safes to stand up under such extreme tests.

Send This Coupon

The Globe-Wernicke Co.
Dept. I. I. No. 80
Cincinnati, O.

Please send without charge your catalog, Sales—Structural Strength Models. All sizes.

Name.....

Address.....

Globe-Wernicke

"BUILT TO ENDURE"

FILES BOOKCASES SAFES

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Agencies or branches in all cities

(*Continued from Page 28*)

from falling between; but even when an actual contact existed initally, the natural wear and elongation of the chains caused an increasing separation, permitting the sifting of material between the buckets, so that, in the aggregate of a day's run, this amounted to a large quantity of material that had to be cleaned up.

A great many devices have been tried to overcome this difficulty; some ingenious, many complicated and cumbersome, most of them abandoned after a few installations; and all failures as compared with the one simple, obvious and entirely successful plan of using overlapping lips on the bucket. The advantage of this lip is now generally recognized as an essential feature of modern installations. The use of this lip, however, introduces a mechanical difficulty, illustrated on Figure 3. In some types of carrier the difficulty is overcome by reversing the direction of travel, that is, referring to Figure 3, the buckets travel up in their carrying position shown at the right, and, after dumping on the top horizontal run, are completely inverted, so as to return on the vertical run, as those shown at the left of the illustration, ready to receive their load again on the lower horizontal run. If they are not completely inverted after dumping, they would return to the lower horizontal run upside down. In other types of this carrier a special mechanism, exterior to the carrier itself, is employed, which tilts the buckets before they enter the lower run, and reverses their lap, as shown in Figure 4. In this type the buckets are in the proper position for carrying on both the horizontal and vertical runs. There is another type of pivoted-bucket carrier on the market, so constructed that the buckets can, if it is desired, make a complete cycle of travel without being titled or discharged.

It is just as well not to completely invert the buckets in dumping, as this only adds to the wear and tear by banging the buckets unnecessarily. Some simple device which tips the buckets just sufficiently to secure a perfect discharge and then returns them, by means of a cam on the side of the bucket, is often used. The trippers for dumping the buckets can be either fixed or of a movable type, and may be moved to any position on the horizontal run, raised to the operative position, for dumping, or lowered to the inoperative position, to allow the buckets to pass. There are also automatic trippers that have a slow continuous travel, reversing automatically at either end of the path.

Although the pivoted-bucket carrier is best known for handling coal and ashes in the power plant and locomotive coaling station, it is also used to advantage for handling sand, gravel, cement clinker, crushed stone, and in fact almost any class of material capable of being handled in buckets. It is a case where higher first cost may be true economy. A good carrier, probably not the cheapest initially, should under ordinary conditions cost little or nothing for maintenance for many years.

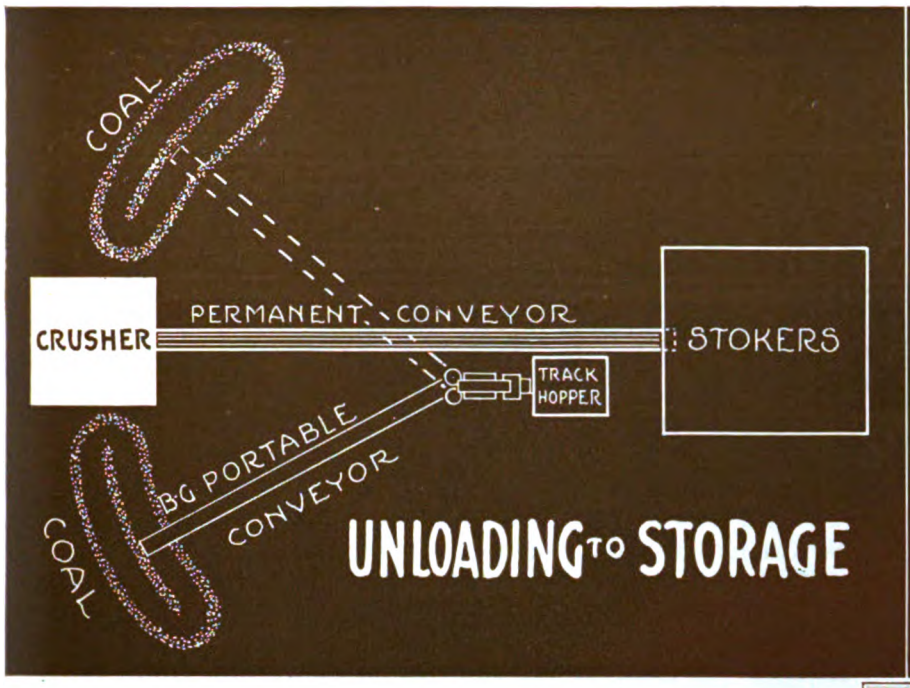
How Machinery Builds Roads

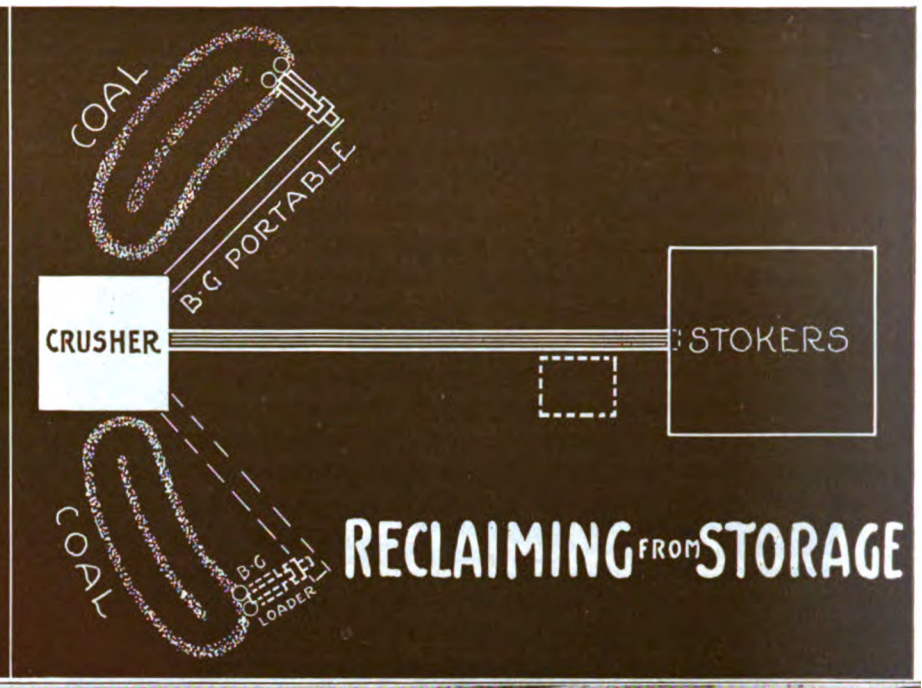
(*Continued from Page 26*

have been able to turn out consecutive batches in as low as 70 seconds, which includes the time for charging the mixer and the time for removing the mixed concrete from the drum. Thus, it is seen that only 10 seconds is consumed in handling a complete batch, 28 cubic feet of unmixed aggregates, a really remarkable performance.

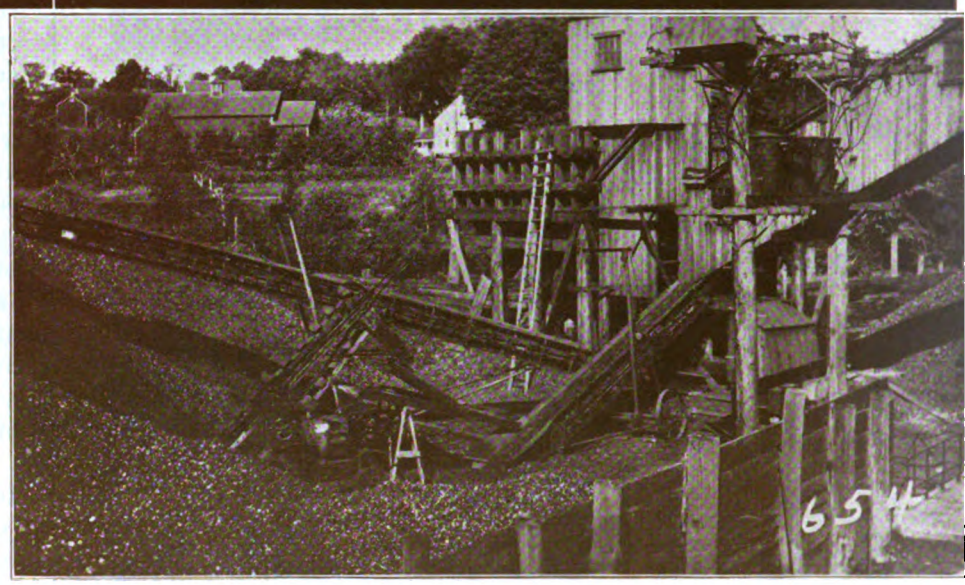
In order to maintain this unusual speed the machine operator must be very alert. While he is discharging one batch from the machine, the material for the next batch is being raised in the charging skip. This is illustrated in the photograph at the bottom of the opening page of this article, which shows the concrete passing from the drum to the distributing bucket, while the charging skip is hoisting the next batch.

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Making "Necessary Evils" Unnecessary



The cost of a night shift for handling the coal required by their seven units of 125 horse power each had always been taken for granted by the Collins Mfg. Co., of North Wilbraham, Mass. Demurrage on coal cars and difficulty in getting labor were also accepted as necessary evils.

They thought they had no coal-handling problem at all.

That's what they told a Barber-Greene engineer when he called.

After he had studied their layout and they had put his recommendations into effect, they found that former "necessary evils" were unnecessary.

Where they used to have a coal-handling night shift, one man feeds the boilers all night long, and the power house pay roll is shorter by ten names.

Instead of paying demurrage on many cars, Barber-Greene Portable Conveyors and a Barber-Greene Bucket Loader carried the coal from a track hopper directly to the crusher or to storage piles. From the crusher it went, via Barber-Greene, either to a storage bin or direct to the boilers. From the storage pile it was also sent on its course via Barber-Greene.

In addition to saving ten men and doing without a night gang, they found that four men could unload a 60-ton car in 30 minutes. The loader operator, with one helper, could put 50 tons through the crusher in 1 hour and 15 minutes. Demurrage charges due to the difficulty of getting labor when cars accumulated, disappeared entirely.

Many other power plants, both large and small, have done similar things with the help of Barber-Greene portable loaders and conveyors, and recommendations for their use as made by a Barber-Greene engineer.

Send for the "E" catalogue and "E" cost reports by tearing out this page and writing your name and address on it.

BARBER-GREENE COMPANY, 470 W. PARK AVENUE AURORA, ILLINOIS

Branch Offices in 33 Cities

BARBER-GREENE

Self-Feeding Bucket Loaders
Portable Belt Conveyors

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Save Floor Space—

use the ceiling.

Do your trucking overhead and make the ceiling pay more on the investment.

Many firms are daily realizing the fact that **Cleveland Tramrails** have reduced their material handling costs to the lowest possible point.

You too, can enjoy these low costs.

There is a standardized **Cleveland Tramrail**—either hand or electric—that will adapt itself to your particular type of hoisting and conveying.

Let us hear from you. May we have this privilege?

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CLEVELAND HAND OR ELECTRIC TRAMRAILS

Getting Figures That Can Not Lie

(*Continued from page 25*)

The Englishman, Babbage, with the same purpose, persuaded the British Government, in 1823, to supply him with funds to develop a "differential calculating engine." It was as ponderous as its name, and never reached the practical stage although some years of time and nearly $100,000 in money were expended on it. Babbage's contributions to the art, however, were important, particularly the idea of recording the steps of the calculation as well as the final result. He took his inspiration from the Jacquard loom in which the needles are actuated to produce the most complicated patterns by means of perforations in a card or a strip of paper. Starting with the same inspiration, another line of inventors eventually produced the player piano, the automatic typewriter and the monotype typesetting machine.

Success was achieved in 1820 by the Alsatian, Charles Xavier Thomas de Colmar, commonly known as Thomas. He invented the first machine which would actually solve any arithmetical proposition. He called it an arithmometer, and, under that name, as improved by Tate and others, it is still used both in Europe and this country. Thomas's originality consisted in using endless ribbons running over wheels, operated by finger grips on each ribbon, thus breaking away from the Pascal dial principle.

With inventors constantly groping for principles and mechanism, another considerable period of years elapsed before a practical improvement was achieved. Roth's calculator, in dial form, invented about 1841, and Maurel and Jayett's rather complicated and bulky machine (1847), were among the attempts made to improve on Pascal's method. The Russian mathematician, Tchebycher, (1871) seems to have adopted something of Pascal's invention and combined it with Thomas's idea. Bollee, a Frenchman, who received his U. S. patent in 1886 and his French letters in 1889, produced a calculating machine which, in its principles and in the workmanship it embodied, foreshadowed the present-day machine. Bollee's machine never reached the stage of commercial manufacture, but a Swiss, Steiger, a few years later utilized his principle in producing a calculator along novel lines, in cylindrical form, called the "Millionaire."

It is instructive to note how better facilities enabled these later inventors to produce the necessarily fine and delicate parts with sufficient accuracy and strength for the purpose; Burroughs, in fact, using the microscope in drafting and the micrometer in his machining. The earlier attempts were handicapped by the absence of these precision instruments and finely adjustable machine tools, as well as by lack of knowledge of the proper raw materials to use.

Meanwhile in America, as already remarked, inventors were striking out along a somewhat different line, both in object and method. D. D. Permalee in 1850 patented a machine operated by the depressing of keys which could only add a single column of figures. The first U. S. patent for an arithmetical recording machine was issued to Barbour in 1872. In the '80s both Burroughs and Felt were at work, the one on the so-called listing, adding machine, the other on the non-listing, calculating machine. They reached the production stage in the early '90s, and since then their history has been that of highly successful commercial enterprises, their problems the problems of adaptation and merchandising. There are in use today some dozen or more different models of adding and calculating machines. One, which has its distinct uses in a definite field, is the pocket calculator invented by Halden in 1906, and shown among the accompanying illustrations. But, from the simple refinement of Pascal's original model to the most elaborate machine which adds and subtracts, multiplies and divides, extracts the square root and the cube root,—seems to do

(*Continued on page 34*)

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When the years have come and gone



Time sweeps his sickle back and forth relentlessly; new buildings age, the doorways sag; under the beating rain, the weight of snow, and the tearing of the wind, the roof gives way—unless it is made of Bonanza "Cementile." In which event the roof remains intact, outlasts the building, is impervious to the attacks of time, if conditions are anyways near normal.

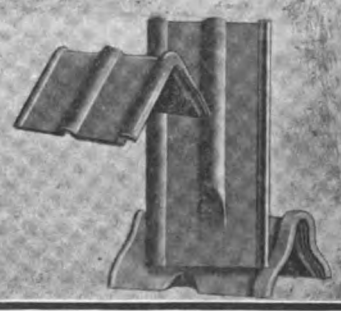
No idle boast, this, but truth. "Cementiles" are slabs of steel-reinforced concrete. They grow stronger with the passing of the years; their molecules knit more firmly together.

There is nothing to wear out or rust away, no repairs to be made. Even fire will not ordinarily harm the roof. One initial cost and you forget about a "Cementile" roof.

What a sense of work well done to know that when the years have come and gone, when,—alas!—you have given your work into the hands of those who follow, the Bonanza "Cementile" roof on your buildings will still be serving faithfully, unharmed by the flight of time.

Our catalogue and data sheets will interest you. Send for them today.

BONANZA CEMENTILE



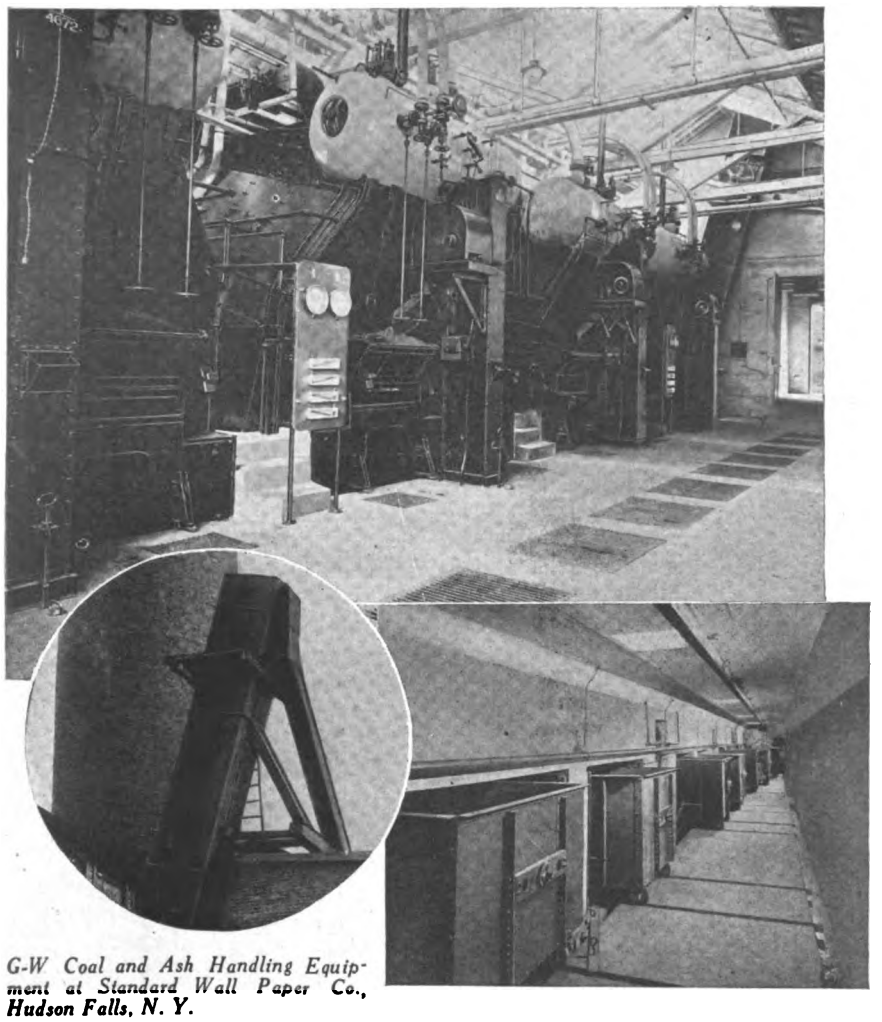
American Cement Tile Manufacturing Co.

831 Oliver Building, Pittsburgh, Pa.

PLANTS: Wampum, Pa. Lincoln, N. J. · Birmingham, Ala.

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G-W Coal and Ash Handling Equipment at Standard Wall Paper Co., Hudson Falls, N. Y.

BUILT STRONGER LASTS LONGER

Thousands of Dollars Saved Through Simple But Improved Coal and Ash Handling Methods

Are you saving, too? Or are you handling your coal and ashes with old-fashioned, inefficient equipment or by the manual method, with its wastefulness in time, labor and money?

That worth while coal and ash handling economies can be effected through the use of simply constructed machinery is well illustrated by the G-W Equipment pictured above. Here, four motor-driven coal elevators take coal from underground storage beneath the boiler room floor, discharging direct to the stokers. All quickly and automatically done—no labor involved.

Ashes discharge from grates into ash carts. These carts when full are picked up by means of a trolley, pushed along to the ash elevator while suspended, and dumped. The elevator then automatically carries the ashes to an ash tank, where they finally discharge into a truck and are carried away.

May we cooperate in effecting coal and ash handling economies for you too? At your request we'll gladly have a G-W representative visit your plant. He would look into your coal and ash handling problem, point out possible economies, and give you complete information regarding G-W Equipment. This service would entail no obligation.

MAIN OFFICE and WORKS: HUDSON, N. Y.
New York Chicago Boston Buffalo

Gifford-Wood Co.

COAL HANDLING EQUIPMENT

Continued from page 32)

everything but think,—every one of them owes something to Pascal, Thomas or Bollee.

The function of the calculating machine today is indispensable. The auditor of the Austria Northern Railway in 1899 was jubilant upon discovering that with an American machine one of his clerks did the work of two or three men, and eliminated the errors which were a constant source of annoyance and actual danger, even when all computations were performed by two men, whose carefulness was reinforced by fines. President Eliot of Harvard once said, "a man ought not to be employed at a task which a machine can perform," and that ideal is being practically applied by the constant and rapid enlargement of the field occupied by calculating machines in the performance of mathematical operations of almost inconceivable variety. To the ordinary observer the mention of an adding machine means the simple listing and addition of his cancelled checks which he receives each month from his bank. But merely to set down the other uses to which clever inventors and clever operators have adapted this wonderful device, in its many up to date forms, would require more space than can be allotted to this entire article. The writer can remember when the makers themselves figured that the adding machine was a profitable investment only in an office where at least four bookkeepers were at work. Noadays, hardly any corner store is regarded as too small for a typewriter, a cash register and an adding machine. It is even suggested that the study of mathematics in schools and colleges must undergo a considerable change, comprehending the principles and applications of the calculating machine as eliminating the tedium and errors of mere lengthy calculations and educating the student better in the mathematical principles he needs to know because his processes of thought are not thrown off the track by mere drudgery, fatigue and accidental slips in simple steps. So the device seems to be completing the circle of its evolution, arriving in practice at the idea with which it started: that of a machine which should aid, not the merchant who was beneath notice with his simple arithmetical problems, but the scientist and student whose computations were on a higher plane in principle and complexity.

Nowadays, thanks to this machine, the engineer is able to assert that the long and tedious computations required to reduce his observations to a working basis lower his output of constructive brain work, and it is difficult for him to imagine an engineering office which would tolerate that now unnecessary inefficiency. Except for higher mathematics there is no engineering calculation which cannot be performed with greater speed and accuracy by machine than by mind and fingers. Even in the difficult field of mining engineering, survey parties take a machine with them into the field and work up all calculations from their field notes before sending them in to the home office so that the draftsmen can go directly to work with their drawings. The U. S. Geological Survey uses them, for example, in recording the voluminous figures of stream-flow, so essential to hydro-electric development. On the great irrigation projects the ditch-riders keep track of the water used by each farmer by means of this device.

The big bakeries use them. The paper mills and cotton mills compute and classify their complicated products with them. Railroads could not be run without them in these days when their figures run into a dozen places both ways from the decimal point. Printers, pumping stations, building contractors, paymasters, cost accountants, grain brokers, creameries and dairies, department stores and lumber concerns, depend on them for the knowledge of their operations which means the difference between profit and loss.

Their adaptation already is comprehensive. If you work with twelve-column figures, with decimals, there is a machine ready-made for you. Do you want fractions — fourths, eighths, twelths, double eighths or twelfths, eighths and twelfths, together? Do you use the peculiar enumerations of British money, lumber, glass, feet and inches, dozens

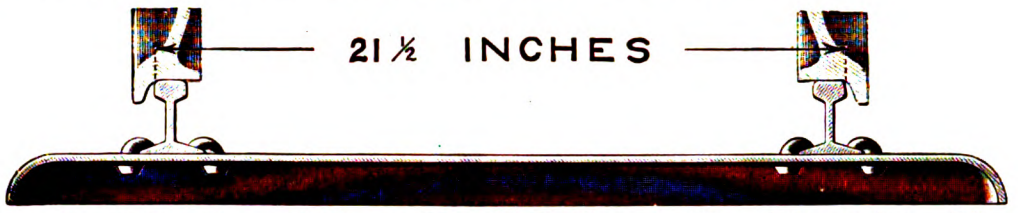
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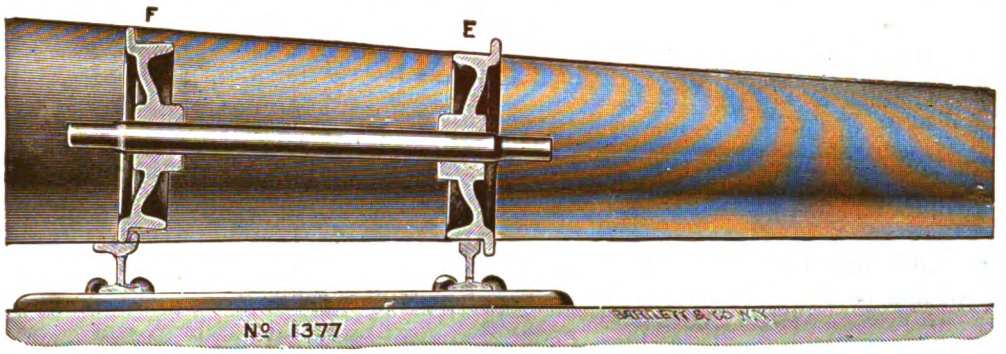
HUNT INDUSTRIAL TRACK and EQUIPMENT

is constructed for every industry and service where the movement of material is essential. ***One man*** can push a ***one ton load*** on a ***Hunt System*** around 12-ft. Radius Curves and Switches as Easily as on Straight Track. The ***secret*** of this Easy Running is in the Construction of the Running Gear, Curves and Switches.

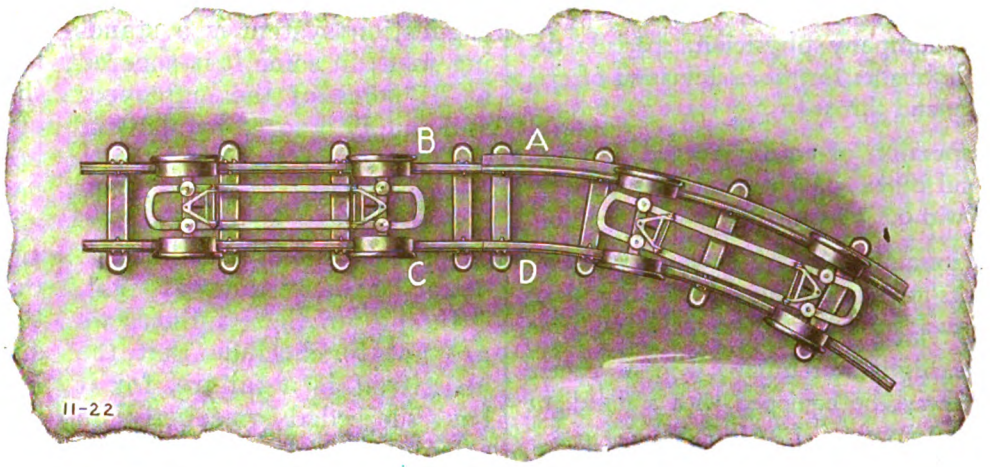
The Gauge of track is 21½ inches, measured from outside to outside of railheads, with the flanges of wheels running on the outside, as illustrated below.



Standard Section of Hunt Track-Rails are Hot Riveted to Ties



Section showing the theoretical cone and circular path assumed by Hunt axle and wheels in rounding a curve. Note that flange of outer wheel rides on special guard rail and tread of inner wheel rides on head of tee rail the same as on straight track, thus forming the cone.



Hunt flexible wheel base showing position of wheels on the straight track and the radial position assumed on the curve

The action of the axles and wheel flanges on Hunt cars in rounding curves is illustrated above. As the car on a straight track approaches the curve, the wheel (B) runs on its flange on the special outer curve rail (A) and the wheel (C) runs on its tread on the inner rail (D). Thus as the axle assumes a radial position there is no slipping on the rails and no sliding friction. Full details will be found in our Industrial Railway Catalogue 22-1. Sent on request.

C. W. HUNT COMPANY, INC.

WEST NEW BRIGHTON, NEW YORK

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Ernest F. Learned
141 Milk St., Boston 9, Mass.

Phillips, Lang & Co., Inc.
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In *your* factory Eveready Flashlights will prove indispensable in preventing fire and accidents!



For the safety of life and property, Eveready Flashlights are as necessary as a sprinkler system, a fire alarm, or a night watchman. Read the following Eveready advantages—

1. **Lighted instantly,** much quicker than matches
2. **Flameless,** no fire risk
3. **Steady,** unaffected by wind or rain
4. **No wires,** no connections to make
5. **No cord,** nothing to catch in machinery
6. **Concentrated light,** a bright electric beam directly where you want it
7. **Handy to carry,** much smaller and lighter than a lantern

Indispensable in stock rooms, to read labels on barrels and boxes

For accurate measurement reading, temporary measuring devices set up in odd corners

For easy reading of counters, always convenient, often necessary

For quick repairs, often made on the spot

For the company physician, specially designed flashlights for the examination of eye, ear, nose, and throat

For inspection of equipment, as sprinkler heads and other appliances can hardly be examined without a flashlight

Where inflammable liquids and gases are, flashlights are recommended by the Bureau of Explosives as perfectly safe; no sparks, no flame

For the night watchman, who of course should always be equipped with a flashlight

For sale everywhere by electrical, hardware, sporting goods, drug, and auto accessory shops; garages; general stores.

NATIONAL CARBON COMPANY, Inc.
Long Island City, N. Y.

EVEREADY
FLASHLIGHTS
& BATTERIES

(*Continued from page 34*)

and gross, hours, minutes that seconds, and so on? A calculating machine that will handle all those peculiarities is in stock. And you or your employee will be taught thoroughly how to operate the machine in such a way as to utilize its full advantages in accuracy and speed, in disclosing the significance of figures in your business which otherwise may escape notice, because the means of ready analysis is not at hand.

Five Essentials of a Suggestion System

(*Continued from page 22*)

wrecked it in every case will be found to be either its administrative laxness or judicial laxness, or both. The first principle of a successful suggestion system is that it be prompt and efficient in handling all suggestions offered; and the second principle, equally important, is that every precaution be taken to insure fairness (and the appearance of fairness) in decisions and awards.

These principles are obvious and may appear to be easy of application. If they are kept in mind from the beginning of the campaign for suggestions it ought not be difficult to steer clear of the dangers. But the truth is that many suggestion systems have failed, and many are failing today. In more than a few American factories the suggestion system is a standing joke; in some it is sneered at by some of the employees and simply ignored by many of the others. A recent writer in *Industrial Management* mentioned the "suggestion-box-corpse" as something that had better be removed out of sight.

In spite of these failures we are not to conclude that the idea itself is a failure, for it has succeeded amazingly in some plants. It has succeeded not only in bringing out suggestions of improvements and economies that without this stimulus might never be thought of, but also in keying up the interest of the employees, in strengthening their sense of loyalty to the plant, and upbuilding industrial goodwill. Certainly these results are wholesome both for employer and employee, and it is worth while inquiring how they have been brought about.

The information which follows is the result of an analysis of suggestion systems in a dozen industrial plants where the idea has been successful. The systems vary in many details, as will be shown, but all conform to certain conditions which are the essentials of a successful system. These we may list as five "musts" as follows:

1. The suggestion system must have an adequate organization, on the job all the time, and so constituted as to command the confidence of the employees.
2. It must devise and employ suitable means to attract the attention of employees to the opportunities it offers and make it easy for them to submit suggestions.
3. It must be prompt in acknowledging and passing on suggestions and fair in judging and rewarding suggestions.
4. It must give awards sufficient to provide the necessary incentive for extra effort.
5. It must be scrupulously considerate of the human factor in every detail of administering the system.

Each of these requirements may seem a simple, obvious thing, but it is amazing how often they are slighted or mishandled. Take the item fairness, for example. The administration of your system might be incarnate justice, but that wouldn't necessarily mean that the men would accept it as such. It must not only be fair but it must *appear* to be fair, it must give a consistent impression of being fair; and that requires more attention to the fifth "must" than you might ordinarily think necessary.

The first essential is that the suggestion system be properly organized. In a small plant the manager or superintendent may constitute the entire organization, with the help of a clerk to care for the filing, typing and other clerical details. But in a large plant the task of giving proper publicity to the system, of caring for suggestions as they are submit-

(*Continued on page 38*)

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Hays Man Saves $540.00 Every Month in Fuel Cost

K. R. Williams, of Charleroi, Pa., cuts coal consumption from 15 to 9.2 tons a day. Engineer Shoemaker, another Hays man, cuts 213 tons to 100 tons a month with an even bigger load. Everywhere Hays students are using their practical knowledge of combustion and fuel saving to make amazing cuts in coal bills. My book on Combustion, sent free, will show you the way to similar savings in your plant.

THE question which all power plants are facing this winter is not so much the price of coal as it is "Will we be able to get enough fuel to keep our plant in operation?" Saving fuel becomes more vital than at any other time in the history of our country.

Run through the advertisements in this magazine and you will find countless mechanical devices for increasing fuel efficiency and cutting costs. But remember, that the boiler-room never can function automatically. Before these mechanical stokers, draft gauges, blower regulators, gas analyzers, etc., can be of practical use there must be the human brain of a directing genius who has a fundamental and thorough knowledge of every phase of combustion. It is this human mind which must put into effect the short cuts to fuel saving and higher efficiency. Not only must he know how to correct and eliminate every condition causing waste, but he must be able to command the respect of the men under him and inspire them to the hearty cooperation that is essential before any plant can get the maxium of power from every lump of coal. Every modern plant should have a Combustion Engineer.

Heretofore, the four years of technical training necessary has made Combustion Engineers very hard to find. But now the Hays School of Combustion is prepared to make any man in your plant a Combustion Engineer, an expert in fuel economy without taking a minute from his job. The training is given in his spare time at home. And the results in every case have been amazing.

The records shown in the panel on this page are only a few of the hundreds which we have in our files. But these are not remarkable when you consider the records of the men who prepared this course. Those whose experience is combined in this training are: Jos. W. Hays, well known writer and consulting engineer; Prof. S. W. Parr, of the University of Illinois,—authority on fuel chemistry; Fred R. Low, Editor of "Power;" David Moffat Myers, prominent consulting engineer and formerly of the Fuel Adminstration; Arthur L. Rice, Editor of "Power Plant Engineering"; W. L. Abbott, Commonwealth Edison Co., Chicago; I. E. Moultrop, Edison Elec. Illum. Co., Boston; and Jos. Harrington, stoker expert.

Savings Quickly Noted

"Already I have made a saving recognized by more remuneration." F. E. Burgess, of Philadelphia.

Fuel Efficiency Wins Recognition

"Have had two raises as a result of the savings I have effected since taking the Hays Course." Gordon Kelly, Cambridge, Mass.

$200.00 Saved Here

"In the last two months I have saved $200.00. At least 50% of this was in coal saved." William Weston, another student.

Cut Coal Bill 15%

"I have cut our coal bill 15%." Edw. C. Grove.

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"Saved 60 tons of coal this September compared with same month last year." George W. Austin, Tuskegee, Ala.

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"Have reduced fuel consumption 10%." L. B, Quam, of the Oil Belt Power Company.

Think over now the men in your plant. Which one is the most apt? Which one would you like to have me train to save fuel for you? Either pass this advertisement on to him with the suggestion that he investigate this course, or call him into your office and ask him if he is interested in becoming an expert in his work. Or, better still, investigate this course yourself before mentioning it to your man.

FREE *WHEN SHALL WE MAIL YOUR COPY OF THIS COST CUTTING BOOK?*

Any Man Can Learn How

The course in Combustion and Fuel Efficiency is so interesting, so clearly written that any man of ordinary intelligence—with no better than a common school education—can master it and become as good and as expert a Combustion engineer as though he had spent four years at a technical school. From the very first lesson he learns principles and what is more important, how to apply them at once in his daily work. This is true throughout the course.

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Chicago, Illinois.

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Address .....

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Company ..... Position .....

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Perfected the Works; Lost the Mainspring!

The experts say that cost-reduction, mechanically, is about finished. It has almost finished the worker, by making his job *too* mechanical.

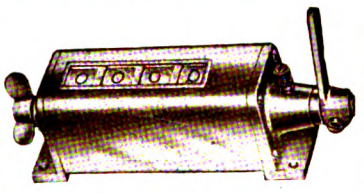
After machinery is all but perfected; after the time of operations has been cut to the last second and rates scaled to the last cent, your men work *mechanically*—without snap!

There's a remedy for this; a way to get a man's pride, interest, initiative and sportsmanship into his job.

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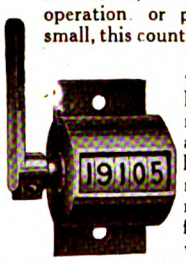
give him a chance to be a record-beater; a chance to *win* over his own past showings and those of his fellows; a chance to gain a little glory and recognition in his line—***a man's mainspring!***

The Set-Back Rotary Ratchet Counter below is for machines such as punch presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-Back *Revolution* Counter of similar model, $10.00 (list.)

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines, and most adaptable for experimental work. If run backward, the counter subtracts. Price $2.00. (*Cut 3/5 size.*) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00



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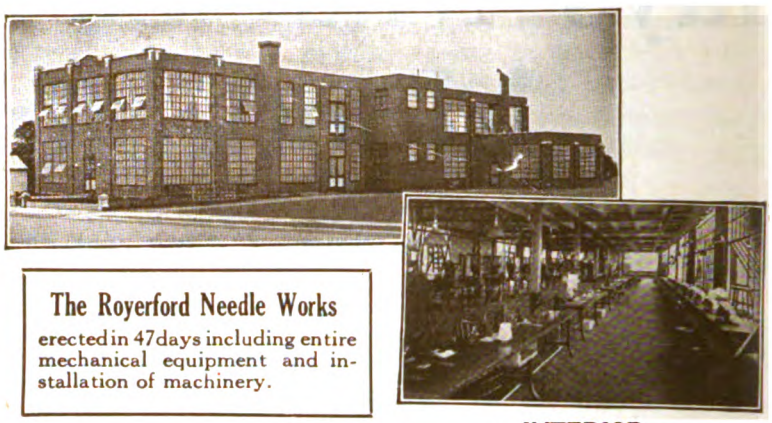
The Veeder Mfg. Co.,
63 Sargeant St., Hartford, Conn.

(*Continued from page 36*)

ted, investigating them. passing decision on them, xing awards, announcing results, and the like, would swamp the executive who tried to combine these with his managerial duties. Moreover, one-man authority in judging and rewarding suggestions is dangerous. It is best to have a group of men—"a jury," to borrow a phrase from the letter quoted at the beginning of this article. Hence the prevalence of the committee plan in the organization of successful suggestion systems.

In a large factory whose suggestion system is a model of its kind, all questions of policy and all decisions and awards are made by a Suggestion Committee of eleven members. Under the committee there is a Suggestion Department of five paid employees who devote their entire time to the work—prepare announcements, posters, and other publicity material; record and file suggestions as they are received; acknowledge them; submit them to the committee; announce the results; conduct the necessary correspondence and interviews with suggesters, and in general take care of all the administrative and routine duties. The Committee is carefully chosen to represent every department of the business and consists of the factory superintendent, the controller, the chief engineer, the office supervisor, the manager of the order department, the assistant sales manager, the chief inspector, the efficiency engineer, the supervisor of assembly, one man chosen from the rank and file, and the manager of the suggestion department. (This is the Committee as it was at the time our inqury was made. The personnel is changed from time to time, but it is kept representative.)

In another large manufacturing company the Suggestion Committee consists of eight department heads. In addition, there is a secretary of the Committee who presides over the administrative and routine details, giving his whole time to this work. While the final decision on all ideas submitted is made by the Committee at its fortnightly meetings, the organization plan here includes the reference of each suggestion as received to the head



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the department it affects. e report of the department ıd assists the Committee in ssing on the availability and ue of the suggestion.

Another company carries the mmittee idea further. There a special committee for each ision of the business, and to all suggestions affecting t division are referred. nen reports from these ecial committees are in, final ision is made by the Sug- stion Committee. The Sug- stion Committee is made up representative executives; functions are purely ju- ial. The administrative and utine work of this suggestion stem is carried on as a subdi- ion of the Department of rsonnel and Employment.

Where there is an employee presentative plan, the sug- stion system is usually under s organization. Thus, a ge implement factory in the est has its Suggestion Com- ttee made up of a chairman ho votes only in case of a), a secretary (who has no te and is the office manager the system), and four mem- rs, two of whom represent e management and two the ployees. This committee is pointed by the works coun- which has the power to re- l a member at any time and point his successor.

In another western plant ere industrial democracy is erative, the Suggestion Com- ttee is a joint body equally presentative of the Senate d the House of Representa- es. The committee meets ekly to canvass the sug- stions received during the evious week, and then sub- ts its recommendations re- rding suggestions to the nate and House, which have e final say in voting awards. general, this plan has rked well, for the recom- endations of the Committee e usually adopted, but there an element of danger in sub- tting suggestions for deci- n to a large assemblage. oreover the system would em to be awkard and time- nsuming. A New York con- rn, whose Suggestion Com- ttee is likewise a joint ap- intment of the Senate and ouse, gives its Committee full wer and responsibility for rrying on the system and aking awards; but the acts of the Committee are subject to review by the Cabinet.

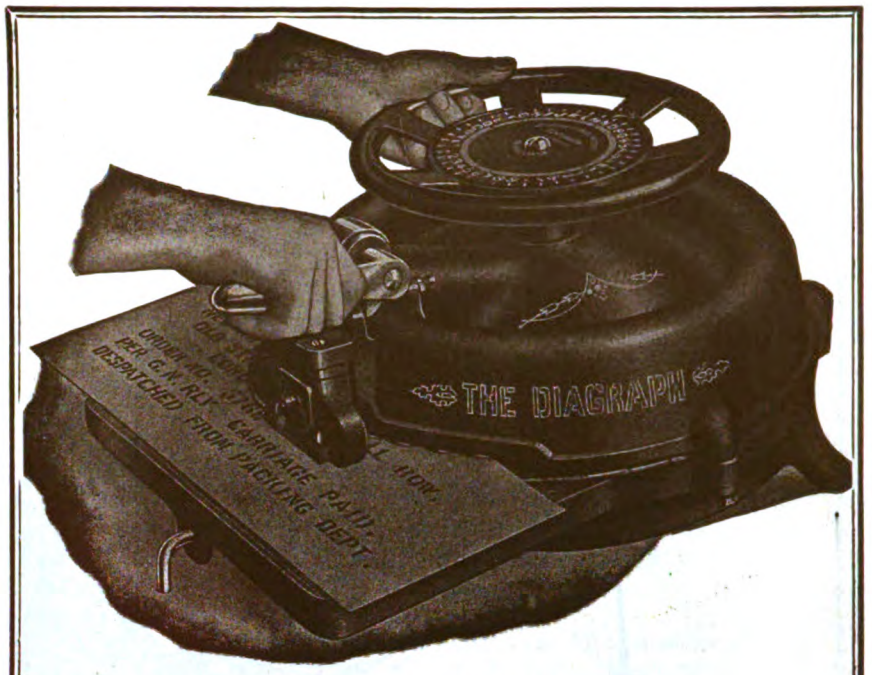
Whatever the general organization of the factory, and irrespective of the size of the force, the committee plan seems the best form of organization for a suggestion system. (A possible exception is a small factory of a dozen or so men, where a committee organization might seem to be top-heavy; but even here it is best to guard against the charge of favoritism by sharing responsibility for judging submitted ideas) A Suggestion Committee should be a representative body, made up of members from the various departments affected by suggestions, and there should be some provision for appeal and re-hearing by the power that created the committee. The latter provision will provide a necessary safety valve for the dissatisfied competitors, of whom there will normally be some under any system.

No matter how representative and admirable its organization, a suggestion system will not win much coöperation from employees by the mere announcement of its existence. Some beating of the drum and blowing of the horn is necessary, not only at the beginning, but afterward, week in and week out. The suggestion department has to stimulate employees to make suggestions, make it easy for them to do so, and in some cases actually assist them in putting their thoughts down on paper. Some of the devices used are posters and announcements on bulletin boards, articles in company magazines, letters pointing out the opportunity offered by the suggestion system, blank forms for suggestions, and lock boxes at convenient places throughout the factory for the receipt of suggestions.

It is usually a help to give the workers a hint or suggestion as to the kind of suggestions wanted. One large machine works, for example, lists the following headings as a classification of the kinds of suggestions wanted:

1. Improvement of Product and Quantity.
2. Improvement of Quality.
3. Decreasing cost without decreasing wage or lowering quality.
4. Unnecessary duplication of work remedied.
5. Improvement of machine design.

(*Continued on page 41*)



READ
"The Freight That Failed"
By Forrest Crissey

Every business man should read this illuminating article in the May 27th issue of The Saturday Evening Post. Mr. Crissey, in discussing the $100,000,000 annual freight claim losses, states that the use of stencils for addressing is a highly effective means of loss prevention. Read Mr. Crissey's article—then buy a Diagraph. Free trial in your own shipping room.

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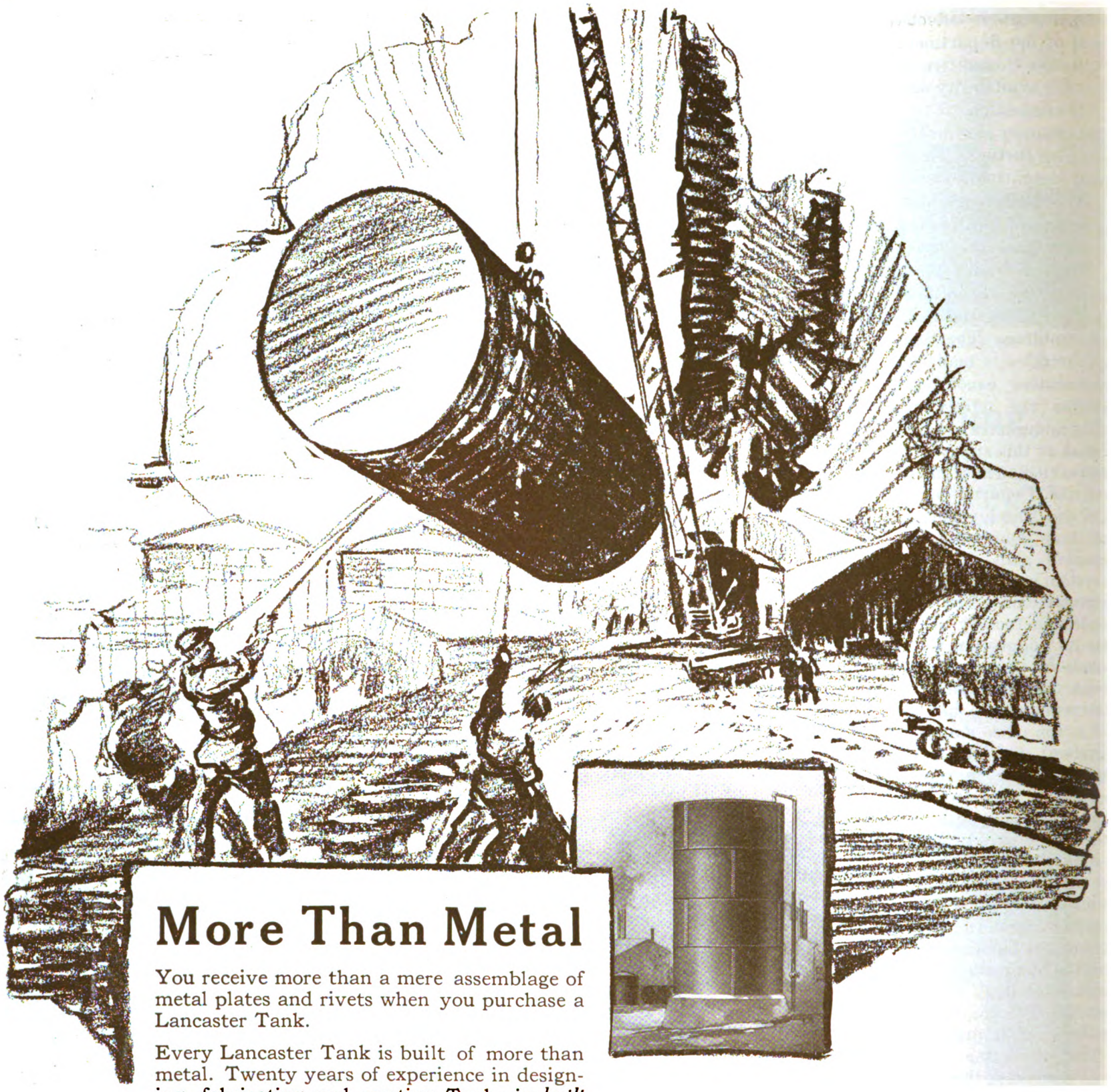


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(*Continued from page 39*)

6. Improvement of design of product.
7. Reduction of labor turnover.
8. Improvement of working conditions.
9. Safety.

A blank form on which sug-stions may be written is also portant, though there should no rule preventing a man om submitting his idea on y kind of paper he may de-e. The presence of these ank forms at convenient sta-ns throughout the plant is a nstant invitation to submit ggestions. Some companies longer require a suggester sign his name. The forms e stamped with a serial num-r which appears also on an ached stub, and when a sug-ster has written down his ea, he detaches the stub, ops the suggestion in a box mails it to the committee, d keeps the stub as his eans of identification. This heme has drawn suggestions om many timid persons who re not willing to sign their mes—afraid of making a lure, of seeming to criticise e foreman or the mange-nt, or of appearing to have a ool idea."

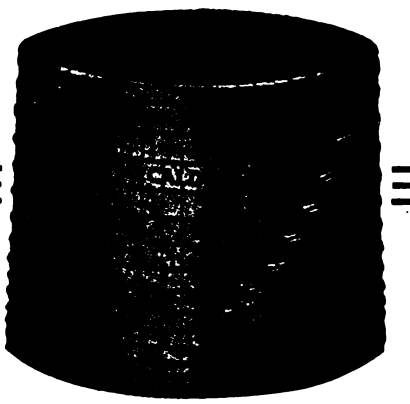
Suggestion boxes are usual-placed near the bulletin ards, at entrances, in corri-rs, and at other conspicuous aces. Some factories have rked out ingenious combina-ns of bulletin board and sug-stion box, with compart-nts to hold blank forms, and chained pencil attached. One mpany found that many of employees didn't like to be en dropping suggestions into e box; they were afraid of ng laughed at. So the boxes re removed from the work-oms and placed on the stair ndings. Now one can drop in paper slip without being en by anyone, and the num-r of suggestions has greatly reased. Last year this com-ny received more than 3000 ggestions.

In addition to mechanical nveniences and aids, some rsonal help should be avail-le to those who want it. me men can tell their idea d explain it orally, but the sk of putting it down on per discourages them. Some-nes a man with a good sug-stion is unable to write, or write intelligibly in English. ere must be some one acces-le in the suggestion depart-ment to hear his idea and help him put it in shape for submission to the committee. Sometimes a suggestion calls for an accompanying diagram; in many companies the suggestion department can call on a draftsman to assist a suggester in illustrating his idea when this is necessary.

The suggestion department should seek in every way possible to popularize the work it is doing. As soon as a new employee is added to the force, write him a letter explaining the suggestion system and inviting him to contribute. As soon as suggestions are accepted, give full publicity to the fact. Exceptional suggestions should be featured. One company issues a regular bulletin reporting the accepted suggestions, and whenever an unusually valuable suggestion comes through it is made known to the force by a special bulletin. Another company has made a stereoscopic apparatus, something like those seen in penny arcades, and displays in this views of new suggestions, how they operate, and the results accomplished.

The time element is an important factor in keeping up interest. If a man submits a suggestion and hears nothing of it for two or three months, he is likely to be discouraged. He ought to get an acknowledgment immediately, and within a reasonable time he ought to know the fate of his idea. Some companies make daily collections for the suggestion boxes. Collection ought to be made at least once a week. As soon as a suggestion is received, a note of receipt and thanks should be sent its author. This note may be a filled-in form, but many suggestion departments prefer to have it appear on the firm's letterhead as a typed letter. Where suggestions are not signed, but are marked with serial numbers, a list of the numbers received for each period may be posted on the bulletin board or announced through the house magazine.

It is a mistake to allow suggestions to pile up in over-large proportions. Committee meetings should be held frequently enough to keep abreast of the collections. Where suggestions are referred to department heads or other experts for preliminary investigation



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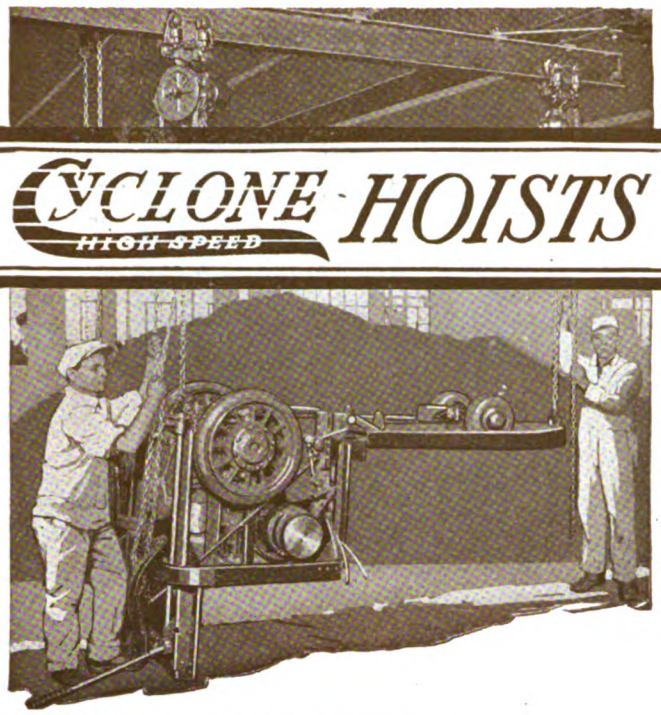
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The original cost is very small and there is no additional maintenance charge.

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and report, the reference should be made promptly by the suggestion department manager or secretary as fast as received. Of course some suggestions will require longer time than others: some can be disposed of quickly by the committee, others may require reference to several authorities before final decision is made; hard and fast scheduling is not always possible, but the suggestion secretary should never permit any stagnation in his department.

Fairness is the prerequisite of a successful suggestion system. It can be safeguarded to a large extent by having a competent and representative committee to pass on all suggestions. But the quality must apply not only to the judgment of the committee in making its decisions and awards, but also to the routine of the committee to pass on all suggestions. There must be a scrupulous regard for accuracy in all clerical operations. For example, it sometimes occurs that two or more people will make a suggestion that is essentially the same idea. The usual practice is to credit the suggester whose idea reaches the department first. The simple operation of time-stamping each suggestion as soon as received thus assumes an importance far beyond that of ordinary clerical routine. And so with all other records of suggestions. Not only are they important in facilitating the departmental work, but in many plants promotions are made on the basis of suggestion records (among other things) and accuracy of the records is essential to fairness in rating the employees.

For each suggestion received the following records are usually necessary: name, date, number of the suggestion, subject, to whom assigned for investigation and report, final decision, nature of award, results.

It is usual in many plants to number each suggestion as it is received, copy it without the author's name, file the original, and send the copy to the committee. This practice is an aid to fairness, for it insures that any prejudice against or favoritism for a suggester will not figure in the judgment on his idea. This is quite an important point, and is emphasized by many suggestion systematizers. The suggestion department regulations of one large factory in Chicago contain this clause: "In no case shall the name of the author of the suggestion be disclosed to the Suggestion Committee until after the award, if any, has been made and approved by the superintendent. If it is necessary for the Suggestion Committee to have more information than is shown on the suggestion form submitted by the employee, the secretary or someone qualified shall be appointed to interview the suggester and report back to the Committee."

Where the original suggestion is not signed, but numbered, the identity of the author is obviously unknown; but even here many suggestion departments find it desirable to make a copy of the original. It safeguards against loss where there is much handling and moreover makes sure that the Committee gets a legible copy.

The employer who assumes that his employees are duty bound to suggest economies, originate improvements, and pass on to him other ideas for the betterment of his business will not get very far with a suggestion system. The average employee has no such notion. The foremen, the department heads, and other executives are expected to make improvements, but they are in a different class from the rank and file. The worker at the machine, or on the bench or in the yard, is employed to do the job laid out for him. Thinking up improvements is beyond his line of duty. It is extra work, and must be recognized as such—and rewarded as such. Otherwise there won't be much constructive thinking at the machine, on the bench, or in the yard.

This means that suggestions must receive some special reward. There must be some special incentive to the workers to think up suggestions. Without the incentive, high sounding announcements and rainbow-colored posters and all the other publicity devices will soon prove to be only much "hot air."

Most companies give cash awards to the authors of acceptable suggestions, but the

(Continued on page 44

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Unloading

Without		With
50 tons	Quantity	50 tons
5	Men	2
9 hrs.	Time	3 hrs.
35c	Hourly Wages	35c
$15.75	Unloading Cost	$2.10
31½c	Cost Per Ton	4.2c
	Save Per Ton	27.3c

(Figures courtesy A. J. Oburt, The Ochs & Frey Co., Allentown, Pa.)

For Unloading, Storing and Reclaiming Your Coal Supply



Storing

Without		With
3000 tons	Quantity	3000 tons
30	Men	4
85 hrs.	Time	85 hrs.
40c	Hourly Wages	40c
$1020	Storing Cost	$137
34c	Cost Per Ton	4.5c
	Save Per Ton	29.5c

(Figures courtesy of Mr. Hazelrigg, Atlantic Coast Elec. R. R. Co. Asbury Park, N. J.)

ask any user

AN enormous saving in time and labor will follow the handling of your coal supply with the Scoop Conveyor.

These are typical cases. Thousands of others just as convincingly prove the necessity for the Scoop Conveyor in every plant.

With this efficient self-contained portable conveyor on hand any open space adjacent to your plant becomes an ideal site for storing coal—without further investment.

Be ready to store your coal supply—and safeguard yourself against an unexpected shortage in case of strikes, floods, storms or other exigencies beyond your control.

Let us submit practical suggestions that will save money for you. Write for Bulletin No. 63.

Portable Machinery Co.
PASSAIC, N. J.

THE SCOOP CONVEYOR

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POWELL VALVES

Backed by 75 Years Experience

Powell Triple Acting Valves automatically close when a tube bursts —isolating the boiler.

POWELL WHITE STAR VALVES

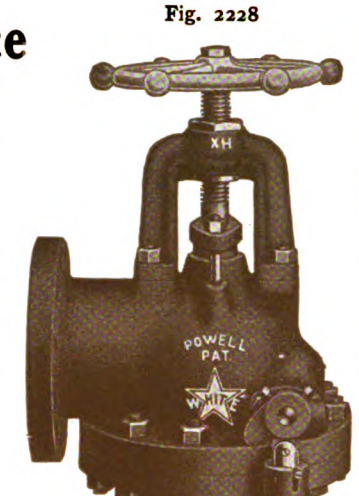
are a combination of the most serviceable mechanical factors insuring to the user unfailing dependability.

Two reasons for their long life are their regrindable, renewable disc, both cast of Non-Corrosive Powellium Nickel.

Medium and extra heavy for steam working pressure up to 200 and 300 pounds.

SEND FOR DESCRIPTIVE CIRCULAR

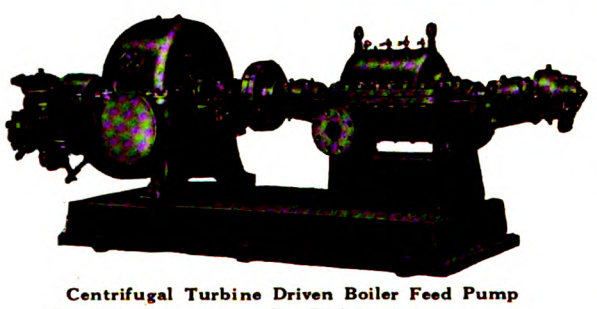
Fig. 2228



The Wm. Powell Co.

2525 SPRING GROVE AVENUE CINCINNATI, OHIO

MORRiS PUMPS



Centrifugal Turbine Driven Boiler Feed Pump

Reliable and Efficient for Boiler Feed —for Fire Protection

Since 1864 Builders of Dredges, Centrifugal Pumps amd Steam Engines

Morris Centrifugal Pumps are rapidly displacing reciprocating pumps for boiler feed. Moreover, many installations are being equipped with these pumps for fire protection. They are built in various stages, usually direct connected to steam turbine or motor. In the 2" and 4" sixes, an especially constructed opposed impeller type is used. A standard multi-stage type is available in the larger sizes.

The Morris Centrifugal Fire Pumps are made in capacities of 500, 750, 1,000, and 1,500 gallons per minute.

Let us help you solve your pumping problems.

MORRIS MACHINE WORKS

200 Genesee St., Baldwinsville NEW YORK

(*Continued from page 42*)

practice is not universal. Some claim that gift articles—a watch, a micrometer, a fountain pen, a pipe, a work-cap—are more appreciated than their equivalent in cash. Of course such awards cannot be made arbitrary—you might find a pipe going to a non-smoker, or a fountain pen being awarded to a man who already possesses two fountain pens. The usual plan here is to list several articles of approximately equal value and invite the successful suggester to take his choice. Different grades of articles are provided for the different grades of suggestions.

Some other companies reward suggestions on a merit basis entirely. The author of an accepted suggestion receives an engraved certificate and perhaps a medal. He may also receive a letter from the president or some other executive acknowledging his service to the company. A suggestion system operated on this plan is usually an important factor in rating men for promotion; when a vacant foremanship is to be filled, the suggestion records are studied closely and play a part in the selection. Such suggestion systems have proven successful in several instances. The extra pat on the back and the assurance that the company is aware of the man's extra effort and has recorded it, serve as a reward and keep the men mentally alert for new ideas to suggest.

By far the greater number of suggestion systems provide cash awards. Some combine the cash award with other features. One large concern, for example, gives each successful suggester an award of money, a certificate, and a bronze medal. In another case, educational trips are given. The author of the best suggestion for the period may take a trip to New York with several days spent in the metropolis, all expenses paid by the company.

In some cases there is a flat amount awarded for all acceptable suggestions. Thus one company gives $5 for every idea that wins the approval of the committee. The usual practice, however, is to fix the amount of the award in some ratio to the value of the suggestion. One company has devised this schedule of awards:

$2.50 each for suggestions which are neither original nor have any appreciable money value yet which shoud be adopted, perhaps with modifications.

$5.00 each for suggestions which are not original but have appreciable money value.

$10 each for suggestions which are not original but have considerable money value.

$10 each for suggestions which are original but have no appreciable money value.

$50 each for suggestions which are original and have considerable money value.

$50 or more for particularly valuable suggestions. (Awards in excess of $50 must be approved by the manager.)

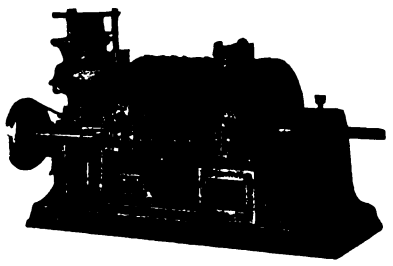
$5 additional award to any employee who submits five acceptable suggestions.

The suggestion manager of a large Eastern factory said that his practice does not favor standardization of awards; but very careful scrutiny is made of each suggestion which gives promise of being acceptable; it is rated individually, and an award is made in proportion to its savings. The savings are determined through the cost department's careful figuring. This company has put its suggestion department on a practical basis of what it will save the company through improvements and economies, and gives less attention to the inspirational features than many others do. The proportion of suggestions accepted is perhaps lower than that in most plants. Awards are generally not given until the suggestions have been put into operation and have been proved practicable. Where the value of the suggestion is not measurable in savings calculable by the cost department, and is yet sufficient to warrant its adoption, the committee itself makes an estimate and fixes the award accordingly.

It is obvious that an extraordinary suggestion ought to obtain an extraordinary reward, and most companies that have successful systems in operation do not hesitate to make an exception from their fixed schedules or ratings whenever a very valuable idea is presented by an employee. In a large Eastern shoe factory not long ago one of the workers was awarded $5,000 for an idea. Of course the $5,000-suggestion comes along only once in a blue moon; most of the suggestions received at this plant draw $10 or less, and as far as their intrinsic value is concerned are probably overpaid at that. But when the big idea is offered, it ought to get

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Pulverized Coal



The Aero Unit System

of Pulverized Coal again demonstrates, as in other work of human endeavor, how an original idea at first worked out by complicated and costly methods is finally simplified and perfected until it becomes a part of our every day existence.

The Unit System reduces the equipment and therefore the cost to a minimum by placing the Aero Pulverizer at the furnace where the coal is fed to the machine undried and is exhausted therefrom directly into the furnace. There are no dryers, no storage or long lines of transportation for the powdered coal, thus eliminating the hazard of fire or explosion.

Each Aero Pulverizer is designed as a complete powdered fuel unit for one furnace. They are built in standard sizes ranging from 600 lbs. to 5000 lbs. of coal per hour.

Bulletin Sent on Request

AERO PULVERIZER COMPANY

165 Broadway New York

an appropriate recompense.

Sometimes a suggestion will result in a patentable device. An important Massachusetts company which manufactures paper and paper products covers this question for its suggestion system in this provision: If a patent is secured as the result of a suggestion, the company will assume all the expense of obtaining the patent and will award an additional prize of $100 to the suggester on the assignment of the patent to the company. Should the patent prove to be of exceptional value, an additional award will be made in proportion.

An interesting system of awards has been devised by another New England factory where the crop of suggestions averages close to 300 a month. Its schedule is as follows:

> For his first accepted suggestion, the suggester receives $3 and a framed certificate signed by the president and vice-president of the company.
>
> For his second accepted suggestion, he is awarded a framed picture of the factory (or, as an alternative, he may choose a framed picture of the home of the founder of the business). Attached to the picture is a metal plate engraved with the name of the suggester and the date of the award. Dates are added to this plate as additional suggestions are accepted.
>
> For his fifth acceptance, a special award of $10 is given.
>
> For his tenth, and every subsequent ten suggestions, the award is $25.
>
> For his eleventh accepted suggestion, the suggester receives the remaining of the two pictures from which he made his choice for his second award, and the new nameplate is engraved with dates for subsequent suggestions in the same manner as the first plate.

In addition to the above awards, extra awards are made by the company for suggestions having tangible commercial value. These awards vary, according to the value of the suggestion, from $5 to $50—though there is no fixed maximum.

To give a competitive character to the campaign for suggestions and stimulate further interest, a special prize of $25 is given at the end of July and December each year to the employee who has submitted the greatest number of accepted suggestions during the preceding six months.

The idea of a prize contest is used by several companies in combination with the plan of individual awards for all suggestions accepted. Thus one company which gives a flat

(Continued on page 47)

COST Accounting

Only School in U. S. Specializing in Cost



"Opportunity" knocks but once.

So don't let this opportunity pass to investigate the J. Lee Nicholson Institute of Cost Accounting, the best school of its kind in existence.

Nicholson trained cost accountants are big valuable men of large incomes. They fill big positions because they know exactly what to do and how to do it. And here is a profession where the demand is greater than the supply.

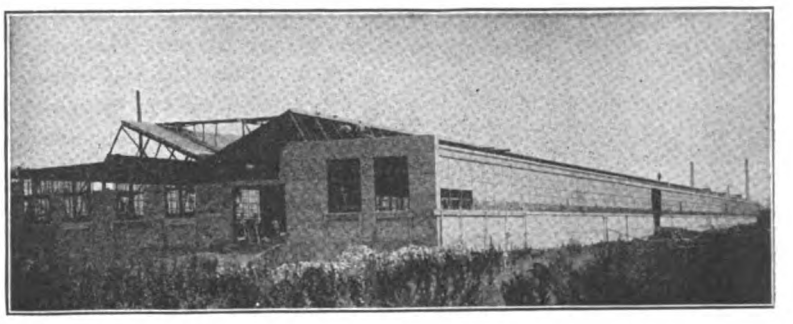
Consultation Free

Send for Booklet

J. Lee Nicholson Institute

Dept. G

6 North Michigan Ave., Chicago, Illinois.



Construction Costs Have Reached the Bottom!

THE cost of building factory structures is at the lowest point since 1913. The increase in demand for additional manufacturing space which is already following the resumption of activities in many lines will soon produce an increase in building costs. Those who need factory space but have waited for the lowest point in building costs can profit by building during 1922.

Thirty Years MRBN of Industrial Buildings

An additional saving can be made by employing "MRBN" Engineers to plan the building for you. Write for one of the members of our firm to come and outline to you our method of handling the design of industrial buildings at minimum cost to you.

Build Now!

MILLS · RHINES · BELLMAN & NORDHOFF

Engineers

TOLEDO · OHIO

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COWAN

Concrete Facts on Electric Lift Truck Economies in Industrial Transportation

TWENTY-TWO men eliminated, with a saving of $66 per day, $19,800 a year, by one Cowan Electric Lift Truck in the plant of a prominent Pennsylvania manufacturer (name omitted by request). This is the saving in wages alone and does not include the many other savings effected through quicker delivery and increased turnover.

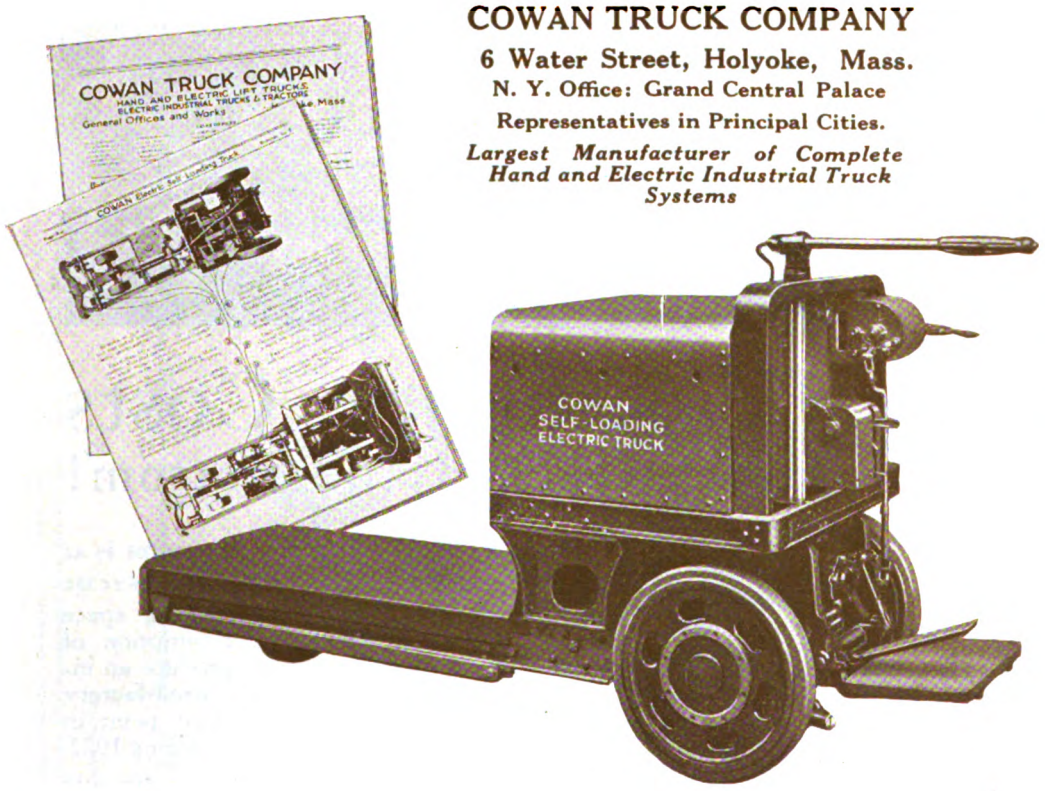
$9720 a year in wages saved, in the Geo. W. Prentiss & Company Wire Works, Holyoke, Mass., where one Cowan Electric Lift Truck has replaced eight men.

$1200 a year saved in wages and many other economies effected by one Cowan in the plant of the Brown-Lipe-Chapin Co., Syracuse, N. Y.

Of the many typical instances which prove the manifold economies of Cowan Electric Lift Trucks, these are but a few. In foundry, machine shop, manufacturing plant, and warehouse, handling a wide variety of goods and materials, Cowan Trucks have demonstrated beyond question their ability to reduce manufacturing and handling costs.

The Cowan Truck and Skid System for material handling is complete in every detail. It includes Cowan Electric Lift Trucks, Hand Lift Trucks, Electric Load Carrying Trucks, Electric Tractors, and Skids—applied individually or in combination, depending upon the requirements of each particular situation.

Cowan representatives are material handling experts. They will gladly study your particular problem and explain how you, too, can profit through the worth while economies of the Cowan system. This service or Cowan Bulletins promptly furnished at your request.



COWAN TRUCK COMPANY

6 Water Street, Holyoke, Mass.

N. Y. Office: Grand Central Palace

Representatives in Principal Cities.

Largest Manufacturer of Complete Hand and Electric Industrial Truck Systems



Handling boxed and packaged goods at the American Warehouse Company, Galveston, Texas. These heavy loads are handled by one man and a Cowan Truck.



One man and a Cowan easily pick up heavy loads of wire at the George W. Prentiss & Company Plant. Note ingenious skid rack.



At the Brown-Lipe-Chapin Plant the Cowan Electric Lift Truck handles boxes, barrels, castings, production matrials, and misellaneous stock room supplies.

COWAN INDUSTRIAL TRUCKS-TRACTORS

Originators *of the* "through ticket" *system for* moving loads

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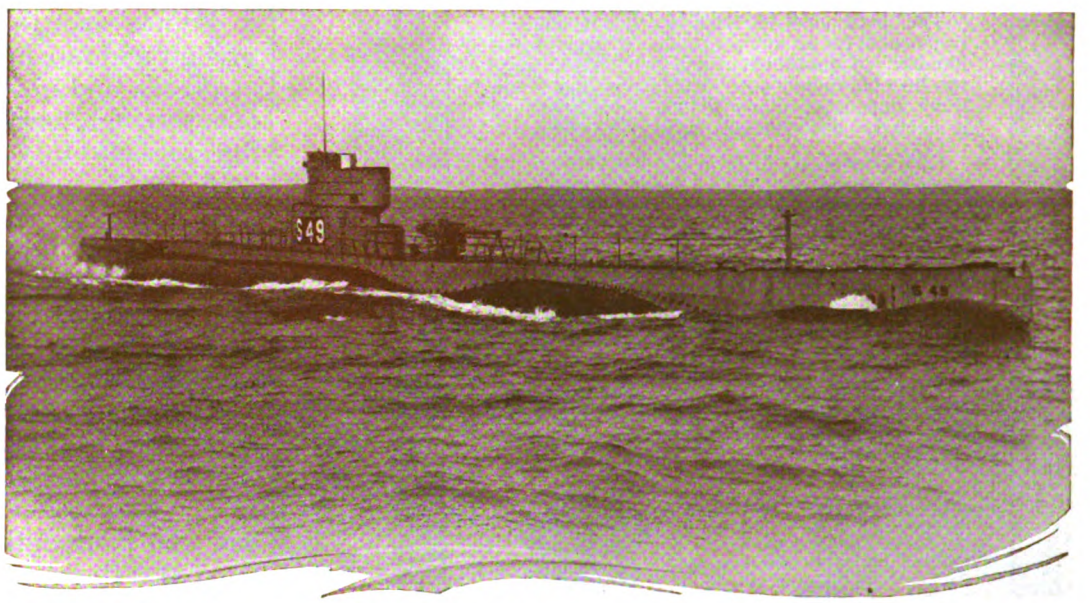
(Continued from page 45)

award for all acceptances, so awards at the end of each ar $100 for the best suggesn of the preceding twelve nths, $50 for the second st, and $25 for the third best. Where the suggestion system conducted on a contest basis, fferent results have been rted. The manager of a sysn which now makes indilual awards for each suggesn accepted, reports that his stem used to be on a monthly ntest basis and was not so ccessful then. "We started t, the first year, with an offer $50 every month for the best ggestion submitted during e month and $100 at the end the year for the best suggesn of the year. This method d not work for the reason at in some months no suggesn received was worth $50. ne next year we changed this d announced that we would ard $50 in prizes each three nths. One difficulty here as the long period in between ards, during which many nployees lost interest. Our esent practice is to make ards every month, and to ve something for every idea cepted."

The contest idea cannot be scarded, however, for one of e oldest and most successful ggestion systems in the untry is run on this basis. It ns two contests a year of six nths each, one ending June th and the other December st. The competition is therere practically continuous. terest is kept up by frequent sters and announcements, d by the offer of a large mber of prizes. Where only ew prizes are offered, many nployees, aware of their own eriority to a few star "sugsters," will give the prospect as hopeless. But where veral hundred prizes are ered, as is the case in this tory, there is incentive for erybody to compete. In a cent competition $8,000 in ize money was offered for e six months' contest; the izes ranged from a first prize $150 cash and a ten-day edutional trip costing $200, a tol first prize valuation of $350, wn to hundreds of $5 to $1 izes. And there were numerus prizes in between these exemes. For example, there ere ten prizes of $35 each, teen of $25, twenty of $20, forty of $15, and one hundred of $10. The amount of prize money varies from contest to contest, but it is always sufficient to offer an incentive to thousands of employees. Moreover, the record of the suggestion department in this plant for the last twenty-eight years is well-known among the employees, and serves as an additional stimulus. They know that during that time many thousands of dollars have been distributed for suggestions. The new employee quickly gets into the swing of this tradition.

An important factor in the success of this company's suggestion system is the character of the publicity campaign carried on by the suggestion department, and the policy of recognizing the successful suggesters not only by awards of money but by public ac-

SKF



Ball Bearings Guard the Safety of Submarines While Submerged

THE vital parts upon which the safety of the crew depends when the submarine is submerged are the main motors which drive the vessel and the auxiliary motors that operate the pumps. If these motors fail serious consequences may result.

For this exacting duty where positive performance at all times is the paramount requisite, motors equipped with SKF marked self-aligning ball bearings are used.

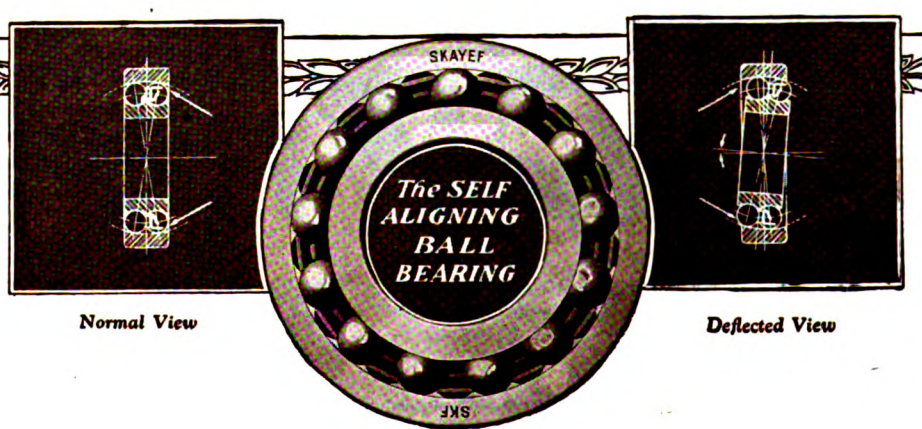
As this type of bearing shows no appreciable wear, the most common cause of motor failure—burnouts due to bearing wear—is prevented. Oil cannot escape from the bearings when the vessel rolls or when it submerges or emerges at steep angles, neither can water enter the housings and play havoc with the bearings.

Wherever performance is the first consideration, whether it be on submarine motors, propeller shafts or in the common machines of industry, self-aligning ball bearings will be found.

THE SKAYEF BALL BEARING COMPANY

Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

804



Normal View

Deflected View

BALL BEARINGS

The Highest Expression of the Bearing Principle

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Economy Says: "Put a Steam Trap Wherever One is Needed"

The high cost of ordinary steam traps is responsible for an annual steam loss aggregating hundreds of thousands of dollars. When traps run into big money you buy fewer of them and leave untrapped many points that should be protected. Valuable heat units are thus wasted.

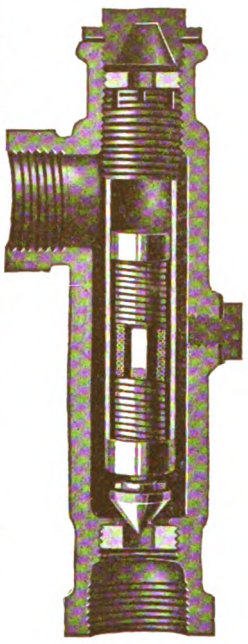
Give your steam lines a sufficient number of traps to take care of the condensate as it forms and you will save money. The solution lies in the moderate-priced Steam Trap Sarco.

The price you pay for a single trap of the "bucket" or "float" type buys three Sarcos. Because of its small size and simple mechanism, the Sarco can be manufactured at low cost and sold at a corresponding figure.

Think what it would mean to be able to drain your lines at many points, or to drain individual heating units, instead of using one or two traps on the entire line!

And besides saving money for you in this way the Sarco also saves in maintenance cost and installation expense. Having but one moving part, the Sarco doesn't get out of order, doesn't require expensive repairs, doesn't balk and interfere with production. And it can be placed anywhere in the line, at any angle. No pit digging or platform building required.

Our 30-day free trial offer enables you to give the Sarco a tryout at our expense. Write today for Booklet R-22.



SARCO CO., Inc.

236 Broadway
New York City

Buffalo **Chicago**
Cleveland **Detroit**
Philadelphia

Steam trap SARCO

knowledgment of them by the executives. Usually, at the end of every six months contest, there is a banquet tendered by the company to the suggesters; sometimes the celebration takes the form of a field day and picnic in the country. Always at the close of the campaign and the award of prizes is marked by some public gathering of the suggesters and a message to them from company executives.

The final "must" of a successful suggestion system is the requirement that those who administer the system have some understanding of human nature. It is not enough that the system be well organized, it is not enough that it be prompt and fair in its handling of details and in its awards, it is not enough that it stand willing to help those who want help. It has to go the "second mile" in its attention to and service for suggesters. Tact, diplomacy, understanding, sympathy, friendliness, patience—these are some of the personal qualities required.

Take the matter of turning down a suggestion. Of course it is easy to handle the successful suggesters; occasionally one who is exceptionally opinionated with respect to his own abilities may feel that he ought to win first prize when he gets only second, or that he should have received a larger award in some other respect; but most employees whose suggestions are accepted are proud and happy and well satisfied with the results. These are only a minority of the suggesters, however; in many plants, only about ten or fifteen per cent of the ideas offered are of any value.

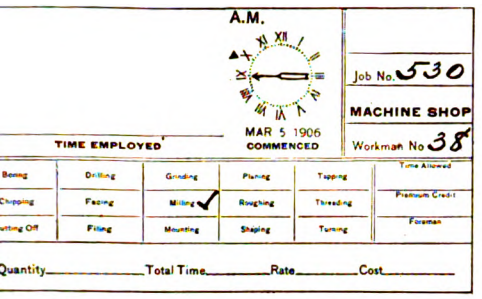
But the rejected idea may be of value to the man who offered it. Usually it is something he's pretty proud of. Maybe it's a pet idea he's been nursing for months, just waiting to get it in shape to spring. It may be the result of considerable thinking about his job. In most cases, he believes in his idea. Then he sees the list of accepted suggestion posted on the bulletin board or maybe printed in the plant magazine. His suggestion is not in the list. Of course he is disappointed.

It is quite important to break the news of his failure very tactfully to this man. Some companies have the letter of notification signed by one of the higher executives, and of course the letter is carefully phrased to carry a friendly tone and encourage the employee to try again. Some companies will not trust to a letter, but invite the suggester to call, and the matter is explained to him in a personal interview. These interviews in some cases have succeeded in pointing the suggester to a new angle of his idea, which, when he worked it over, became practicable and acceptable. In any event, the interview enables the suggestion secretary to come into contact with the man, to "let him down easy," and to encourage him to keep coming with suggestions.

The rule works both ways. Not only must every precaution be taken to keep the good will of the unsuccessful, but every good means must be used to make the most of the successful ones in promoting interest in the suggestion campaign. Featuring the exceptional ideas in bulletins and plant papers, running pictures of the prize-winning suggesters, making an event of the exercises incident to the giving of awards—in these and many other ways valuable publicity can be won for the suggestion system at the same time that honor and credit are being given the suggesters.

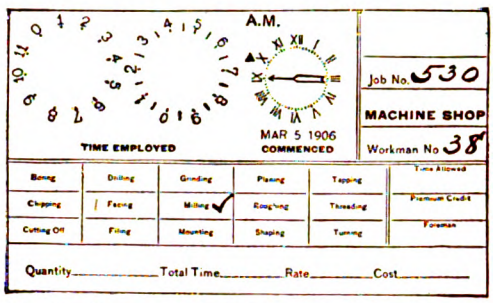
An important thing to remember is that one of the most valuable returns from a successful suggestion system is the good will of the employees and their increased interest in the plant and its operations. This return is impossible to secure, in the average plant, by mere justice. There must be in addition the warming quality of human interest. Friendliness, fairness, promptness—do they not sum up the essentials?

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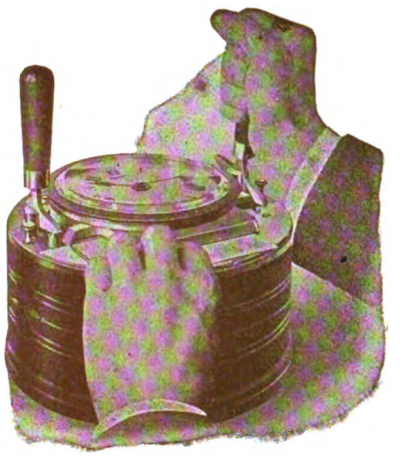
. 1. SHOWING FIRST OPERATION, TIME-OF-DAY
Pushing the right-hand lever away from the erator prints the date and time of day. The row in this dial indicates the minutes and e wedge shows the hour.

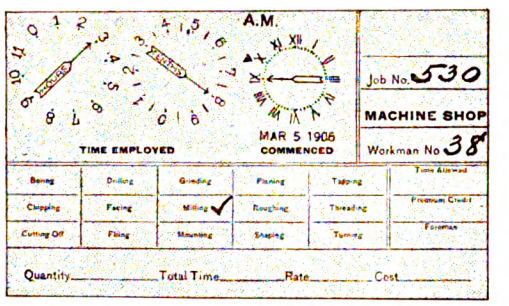




No. 2. SHOWING SECOND OPERATION, ELAPSED TIME DIALS

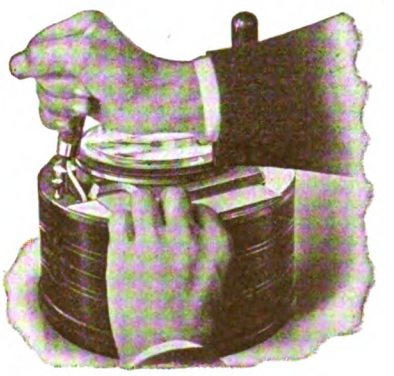
Pulling the right-hand lever toward the operator prints the dials which form a part of the elapsed-time record. These dials are printed immediately after the time-of-day record is made and before the card is removed.





No. 3. WITH ARROWS SHOWING COMPLETE RECORD.

Pulling the left-hand lever toward the operator prints the arrows completing the elapsed-time record. Both elapsed-time dials revolve with their respective arrows, thus making it possible to obtain the records of any number of employees from one Calculagraph.



Here are the three steps by which the Calculagraph Records "elapsed time"

THE complete record shows that workman No. 38 commenced work at 9:45 A. M. March 5 and that he performed a milling operation on Job No. 530, in two and eight-tenths hours.

The complete record is printed right on the job ticket showing the starting, stopping and *elapsed time*.

If you have never seen the Calculagraph it would be well worth your while to investigate it.

A copy of our booklet, "Elapsed Time Records," will be sent upon request.

THE CALCULAGRAPH

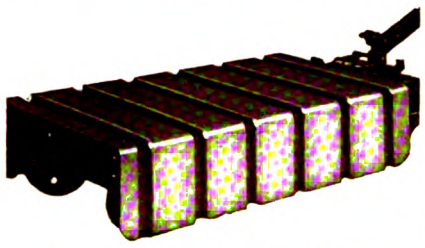
THE ELAPSED TIME RECORDER

34 Church Street, New York City

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TRUSCON ALLOY PLATFORMS STEEL

Used in connection with Lift Trucks



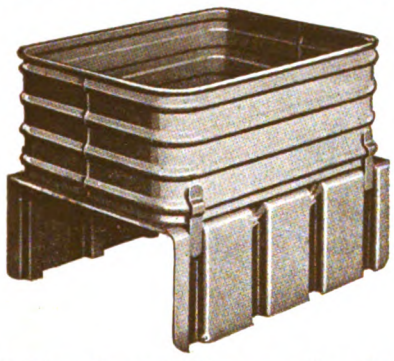
Because of Their Convenience

Every time materials are placed on the floor, money is wasted. To lift and place them costs money, and to set them down costs money. More than half of this constant expense is avoided by using the Truscon Alloy Steel Platform. To place the materials on a platform is even easier than to put them on the floor. Moreover, the hand operations of lifting the materials from the floor and piling them on the truck are altogether eliminated. The platform when loaded is quickly moved along by means of a lift truck.

Because of Their Durability

Any platform will save money in the ways described, but the maximum economy is secured thru the use of the Truscon Alloy Steel Platform. Formed of one piece of heavy gauge pressed steel stiffened by deep ribs, the Truscon Alloy Steel Platform stands up under hard use and saves repair expense. It does not get out of order nor wear down like wood; its clearance height remains uniform and the full width is available for inserting lift truck. Furnished in numerous sizes to meet varied conditions.

Truscon Boxes for Steel Platforms



Skeleton boxes fitting any size platforms are furnished in various depths. They are either welded securely to the platform or equipped with steel stakes which slide into the ribs of the platform. Made of heavy gauge steel, reinforced with deep stiffening ribs and flanged edges. We make boxes to meet every requirement.

Tell Us Your Requirements for Anything in Pressed Steel Parts

Truscon Steel Company

YOUNGSTOWN, OHIO

Sales Offices in Principal Cities

Weighing Materials "On the Move"

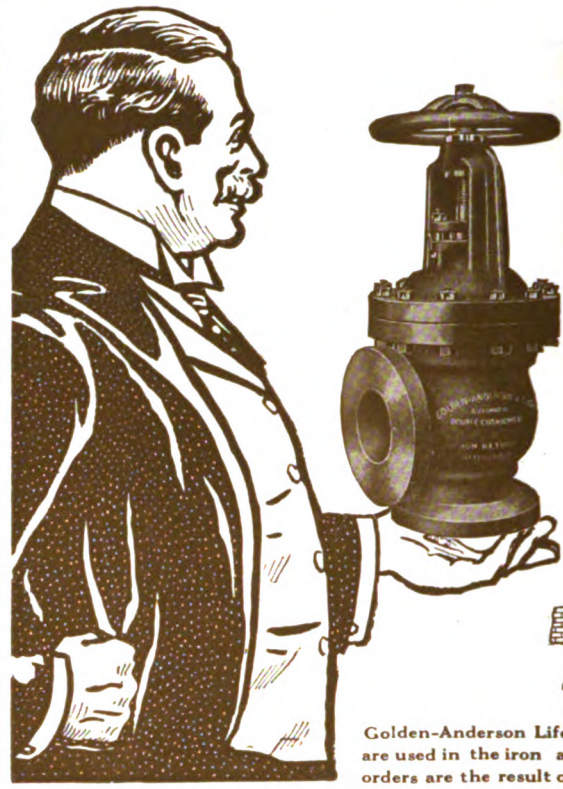
(*Continued from Page 23*)

or and weighed in transit. At hundreds of other plants, this same method is used for billing out material. The Michigan Limestone & Chemical Co., Rogers, Mich., for instance, sell all their stone over conveyors. This plant ships between five and six million tons of stone yearly; the shipping season only lasting approximately eight to nine months. Therefore, it can be readily seen what a difficult matter it would be to obtain the weight of such large quantities of stone if not handled by conveyors and weighed in transit. Here the stone comes from the crushers, is delivered to a system of conveyors, which carry it to bins or outside storage; other conveyors are then used to move the stone to the boats or barges and on each loading conveyor the weight of the stone is mechanically recorded.

In a prominent New England paper mill, not only is the coal weighed as it is received, but during the process of paper manufacture wood chips and sulphite laps are weighed as they are conveyed. Prior to the installation of this method the chips were recorded on a cordage basis, regardless of moisture content and grade of pulp wood, while the laps were weighed by hand with a consequent employment of several weighman.

The ore mining and refining industry uses this same system for checking the ore as it comes from the mines, for the payment of wages to contracting miners, for the payment of royalties to the state, as well as for the determination of concentration and for billing out the concentrates. By having checks hourly or daily, they are assured a steady flow to all departments of the plant. No department therefore is under or overloaded, choked or intermittently run; so that the whole plant operates at a maximum amount of efficiency.

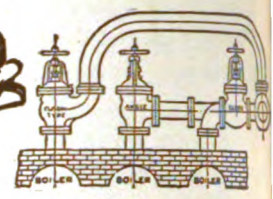
Another adaptation of the principle of weighing in motion is the weighing of cable cars while in motion over a track scale, thus obtaining the weight of the material without stopping the cars. This idea has also been recently



DOUBLE EXTRA HEAVY Valves

"Every Valve Sold With a Positive "Guarantee." "Hosts of References."

"The Heaviest Valve Made"



4100

Golden-Anderson Life and Property Insurance Valves are used in the iron and steel industry. Their repeat orders are the result of assured protection.

GOLDEN-ANDERSON

"Life and Property Insurance Valves"

Patent Automatic Double-Cushioned Triple-Acting and Non-Return Valves

1. They will automatically cut a damaged boiler out of service—making it impossible for live steam to pour back into it and cause a disastrous explosion. The other boilers are left intact, and can be continued in operation.
2. They will automatically shut off the steam flow from all boilers the moment that pipe ruptures, thereby eliminating a pipe explosion.
3. A fresh boiler is automatically cut into the line, eliminating the serious danger involved when doing this by hand.
4. The pressure is automatically equalized between all boilers.
5. No steam can be turned into a cold water boiler, thus protecting men working inside.
6. Fitted with double Corliss dashpot which insures perfect cushioning in opening and closing.
7. No pounding, sticking or spinning.
8. The only valves that can be tested in service.

Golden-Anderson — **Automatic Cushioned Controlling Altitude Valves**



For automatically maintaining Uniform Stage of Water in Tank, Reservoir or Standpipes. Doing away with the annoyances of Freezing and Float Fixtures inside or outside of Tanks. Three Ways of Closing "These Valves."

1st—Automatically by Water.
2nd—By Electricity, if desired.
3rd—By Hand

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so connected as to "work both ways" on a single line of pipe.



GOLDEN ANDERSON

Patent Automatic Double Cushioned Check Valve

1. Perfectly control the reverse flow of water in case pump stops to eliminate water hammer or shock.
2. Can be adjusted to operate either quickly or slowly.
3. Especially adopted for irrigation systems, water works, etc., having disastrous reverse flow of pressures.
4. Perfect cushioning obtained by water in opening and closing.

Sizes to 30" Angle or Globe Pattern.

Especially adapted for Hydraulic Elevator Service



Golden-Anderson Valve Specialty Co

1306 Fulton Building **Pittsburgh, Pa.**

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adapted to the weighing of grab buckets of coal as they are drawn from the storage pile. This system is installed at the plant of the New York Steam Corporation, New York City. Here are found two monorial hoists or man trolleys, which travel down the boiler room to the coal pile. Upon drawing up a bucket of coal the hoists travel back over the boiler stokers and deposit their load. While the hoists are traveling down the boiler room the coal in the bucket is automatically weighed and its weight recorded on a totalizing counter; the man operating the trolley having nothing whatever to do with the weighing.

To the small user of that best known commodity, coal, check weighing against bills of lading seems an expensive luxury; yet one department store found it saved enough money the first year to pay for the installation many times over. This company during the year was billed for seventy thousand pounds of coal which it did not receive. The weights on the bills had apparently been raised ten thousand pounds per car.

Material Handling in the World's Most Modern Sugar Refinery

(*Continued form Page 14*)

steel and brick, three bays wide, and runs the length of the dock, with a crane in each bay. In storage, the bags are piled 22 to 25 high, to be drawn from when no vessel is unloading.

When sugar is to go directly into the refining process, cranes deposit the bags on cutting tables, where they are opened and the contents dumped into crushers. The function of the crusher is to disintegrate lumps which may have formed while the "raw" sugar lay in bags, under pressure, or exposed to excessive heat or moisture. From the crusher the loose sugar falls into the first of the conveyors shown in accompanying photographs. These are slow-moving machines of the pivoted-bucket type, each bucket carrying approximately 130 pounds of sugar.

The raw sugar conveying system is so designed that loose sugar may be carried (1) directly into the refinery, (2) deposited in a storage bin during the day shift, or (3) drawn off from the storage bin at night, and (4) elevated to the refinery. (During the day, bags are being "cut" continuously, but during the night shift, no bags are handled, and sugar is drawn from the storage bin, located in the Raw Sugar warehouse.)

Coming from either the bag-cutting tables or storage bin, the same conveyors above-mentioned elevate the sugar to the 7th floor (top), for the first step on its journey through the refining process. This is known as the "Wash House", and is, as its name implies, the *laundry* for raw sugar. Immediately after being dumped from the conveyors, the sugar is mixed with water and molasses and is then "washed" in centrifugal machines, and the sugar (now in liquid form) passes down through five floors of the wash house by gravity. Through the "Filter House" and to the "Pan House", successive steps in the process, the liquid sugar flows through pipes, entailing no elevating or conveying equipment other than pumps.

After the liquid sugar, ("liquor", in the sugar man's parlance), has been purified or decolorized by passing through the filtering process, it passes into large copper vessels called "pans" in which it is boiled until crystallization takes place, from the pans being drawn off (by gravity) into open tanks to slightly cool. From these tanks the mass of syrup and sugar crystals passes down through centrifugal machines, where the syrup is spun off. As the process machinery is arranged in this building, the sugar has now passed by gravity from the 7th to the 4th floor, and from this point it must again be conveyed mechanically. At this stage the sugar is in a refined

(*Continued on Page 53*)

BYERS PIPE

GENUINE WROUGHT IRON

1 *Home of R. L. Patrick, Burlington, Vt. Architect, F. L. Austin. Byers pipe used for Plumbing, Heating and Vacuum Cleaner lines.*

2 *Masonic Temple, Chicago. Erected 1889. Byers pipe used for Plumbing and Heating Systems.*

3 *The old London and Liverpool and Globe Fire Insurance Bldg., New York City. Erected 1882. Byers pipe used for Heating System.*





40 Years' Service and Still Like New!

SUCH is the record of six miles of Byers pipe installed in the heating system of the old London and Liverpool and Globe Fire Insurance Bldg., New York City, erected 1882.

Another striking example among many is found in the Masonic Temple, Chicago, erected 1889, in which Byers pipe has for 33 years maintained its original serviceability.

Wherever you travel, equally impressive records of pipe durability can be found in old buildings equipped with the genuine wrought iron pipe—the only kind of pipe ever made by Byers. The Tacoma Building, Chicago, America's first skyscraper; the Iroquois Hotel, Buffalo; the German Insurance Building, Buffalo; Cleveland Arcade and Garfield Building, Cleveland—these are just a few notable examples.

In many of these buildings, plumbing and heating fixtures have been replaced by more modern equipment, but the old pipes have been left undisturbed, being in an excellent state of preservation after 30 to 40 years' service.

And this is a most fortunate circumstance, for cutting into walls, floors and ceilings to replace rusted-out pipes, is an operation entailing staggering expense, loss of rentals, endless confusion, and inconvenience to occupants.

Whether you build a home or a large building, Byers pipe is the most economical pipe to use for Plumbing and Heating. It represents the "happy medium" in *first* cost, and —due to its high rust-resistance—the lowest *ultimate* cost.

NOTE: **Black or galvanized pipe of every variety is erroneously called "wrought pipe" or "iron pipe". Byers pipe is made by the old puddling process in use for over a century. The rust-resisting quality of the metal thus obtained has never been approached by products of cheaper modern processes. Byers is the genuine wrought iron. Judge its future by its past.**



Genuine wrought iron pipe, from County Jail and Criminal Court Bldg., Chicago, in perfect condition after 44 years' service.



A. M. BYERS COMPANY
PITTSBURGH, PA.
Established 1864

New York Philadelphia Boston
Chicago Cleveland Houston

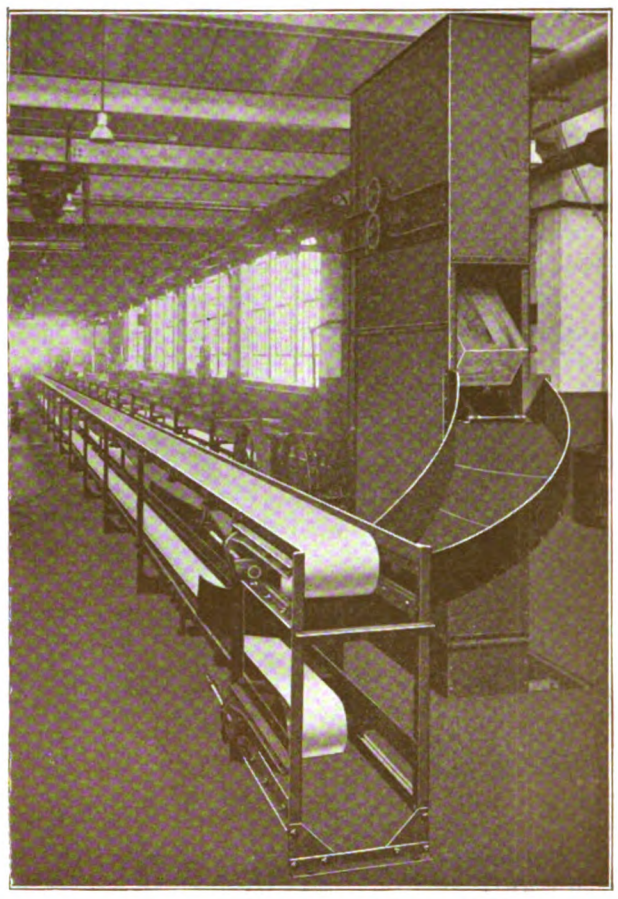


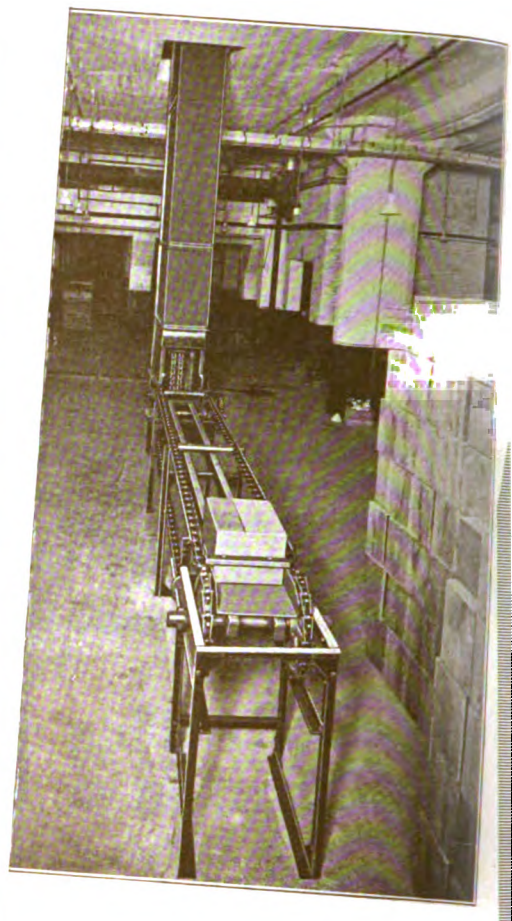
Send for Booklet, "On the trail of Byers Pipe"

Look for the Name and Year rolled in every length

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Survey Your Plant Through The Eyes of Your Competitors.

SYSTEM immediately becomes the mooted question. True, productive machinery, such as machine shop equipment, mixers, looms, filling machines, etc., is practically standard. The equipment of this class that they have you have. But are you keeping your materials on the move so that all machines are producing constantly. That's the biggest factor of business today. And to keep products in the various stages of manufacture on the move you must use Conveying Systems.

Conveying Systems eliminate manual handling of materials, waste motion, keep operators supplied continuously with work, establish a working pace for employees thereby controlling production and carry finished product to stock room or shipping department. *Just what would a Conveying System mean to your business?* A greater productiou with present payroll which means increased sales and more profits.

Conveying systems to function properly must be designed to meet your requirements. To determine your needs an analysis must be made of your methods of manufacture which involves study of operations, routing of materials, determining maximum production and the securing of necessary data from which a Conveying System which will keep materials on the move in your plant can be designed.

We will gladly have one of our representatives call so that this matter can be discussed to your entire satisfaction.

SAMUEL OLSON & CO.

Loose, Bulk and Packed MATERIAL HANDLING SYSTEMS

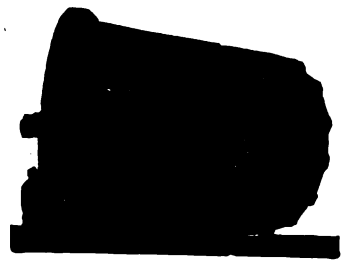
2418-26 Bloomingdale Ave.
CHICAGO, ILLINOIS

5th Ave. Bldg.
NEW YORK, N. Y.

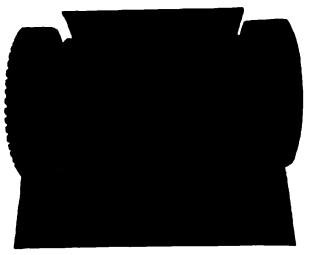
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PUZZLING Reduction Problems Occur in Almost Every Industry

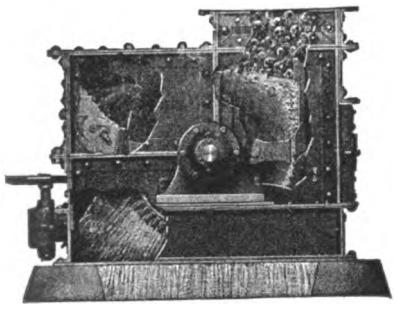
"Pennsylvania" Crushing and Pulverizing equipment has been specialized for crushing and cleaning Bituminous Coal for Power, Gas and Coking purposes, and for the primary, secondary and fine crushing of Cement Rock, Limestone, Gypsum, Ores, Sinters, Chemicals and other Materials of similar structure and hardness.



"Pennsylvania" Patented Bradford Coal Breaker and Cleaner for Coal Mines, By-Product Coke Plants, Central Stations and Gas Works.



"Pennsylvania" Single Roll Crusher for Industrial Power Plants, Gas Works and Coal Mines, in tonnages 10 to 500 tons hourly. (Patented.)



"Pennsylvania" Hammer Crusher for the fine reduction of Limestone, Cement Rock, Oyster Shells, and similar materials. (Patented.)

"Pennsylvania" Crushing and Pulverizing Machinery is distinguished by powerful steel construction, liberal proportions and thorough tramp iron protection, and is specialized for continuously delivering the specified quantity and quality of product in each class of service attempted.

Put your knotty reduction problems up to us.

PENNSYLVANIA CRUSHER COMPANY

Stephen Girard Building, PHILADELPHIA

NEW YORK PITTSBURGH

(*Continued from Page 51*

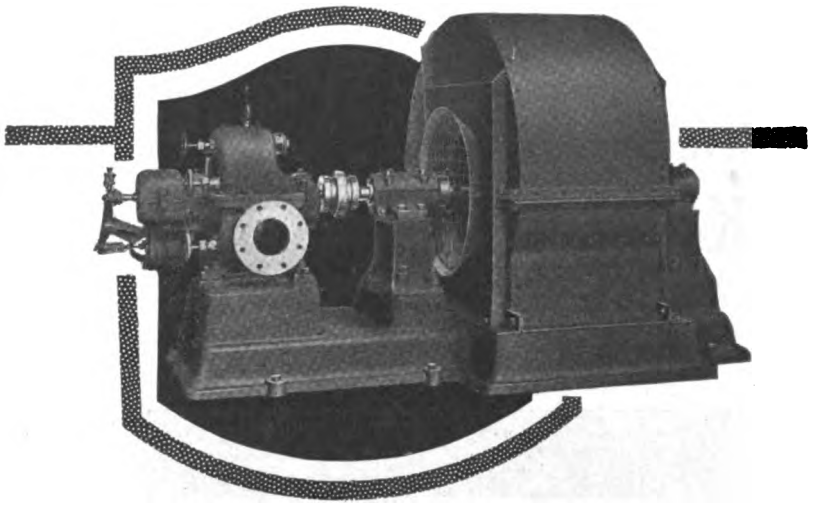
state and pure white, and must be handled so as to be kept perfectly clean.

Continuous conveyors, with buckets of solid cast aluminum, carry the sugar from below the centrifugal floor to the roof of the finishing department, an elevation of approximately one hundred feet. The finishing process involves complete drying and cooling, and screening for the various sizes required for domestic and wholesole trade. Through this part of the "finishing touches" sugar travels by gravity from the roof down through six floors of the building, to a maple lined storage bin, stopping at the 3rd floor. From this storage it drops into either bag-filling or barrel-filling and weighting machines, for bulk shipments, or may be conveyed to the small-package (cartons and cotton bags) filling department. For the latter purpose, the most unique conveyor has been designed and installed. It is also of the continuous type, with solid aluminum, pivoted buckets, each bucket holding approximately sixty pounds of refined granulated sugar, filled by means of a special loading device which permits the sugar to fall into the center of the bucket. Thus the loading is made mechanically uniform, no sugar is spilled, and no sugar comes in contact with any other part of the conveyor than the aluminum bucket itself. The conveyor traverses a horizontal length of 225 feet and elevates 106 feet, changing direction six times, (to conform with the building), but the sugar does not change its position in the bucket during this 6½ minute trip—thereby retaining its original finished lustre and sparkle, and at the same time being absolutely free from dust.

Finer grades, and the so-called "powdered" sugars are processed by gravity, much the same as wheat passes down through a flour mill, and require little or no conveying machinery other than feeders.

In the "filter house," where the sugar liquors are decolorized there are four elevating-conveying units of unusual interest. As previously mentioned, the filtering medium is bone charcoal or "bone-char," which is used and reburned be-

for Forced or Induced Draft



IN the selection of draft equipment it should be recalled that the most essential characteristic of the driveing element is adaptability to speed regulation. When regulation is obtained by throttling the air from the fan there is a loss in efficiency which cannot be recovered. Regulation which varies the speed of the driving unit to compensate for the variety in draft requirements avoids throttling and permits higher overall efficiency. The Terry turbine has the utmost flexibility; in other words, its speed may be regulated to meet the exact requirements of the blower. When used in conjunction with mechanical stokers this speed regulating may be done automatically so that the best combustion efficiency is constantly maintained. Of the 8000 or more Terry turbines now in operation, 1800 of them are used for driving blower equipment. This is why designing and operating engineers say that because of such broad experience you cannot go wrong if for your forced or induced draft service you

Specify

T-773

THE TERRY TURBINE

Offices in Principal Cities in U.S.A. also in Important Industrial Foreign Countries

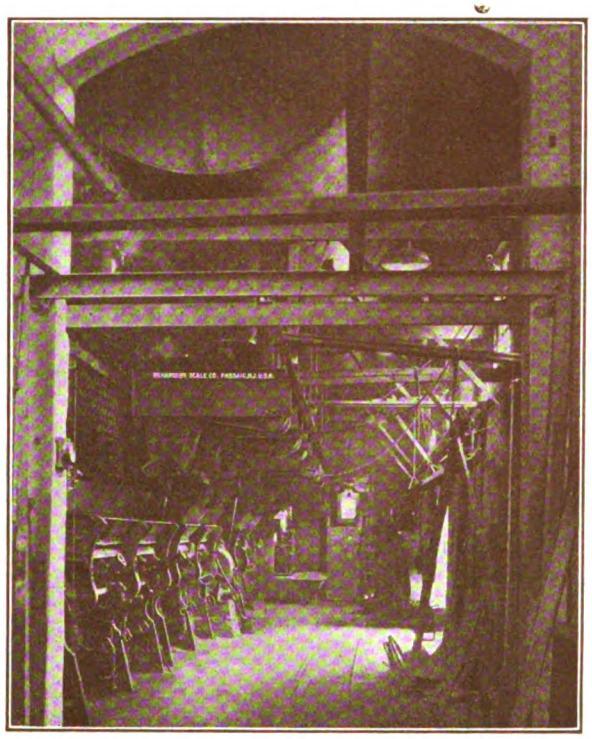
The Terry Steam Turbine Co. Terry Sq. Hartford, Conn. U.S.A.

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A Watch Dog In The Boiler Room

Power Losses are Always Heavier When Coal Prices Are Soaring

Keep Tab On Your Consumption



Use A Richardson Automatic Coal Scale To Check Your Boilers

Scale receives the coal from overhead bunker, weighs it automatically and delivers it in a steady, even stream to stokers.

Fires kept steadily supplied. Scale counts and records every draft and tells you which boiler is using the most coal.

A small length, wide, slow speed conveyor belt (part of the machine) feeds the coal to the scale hopper. No restricted openings to choke up. Weighs predetermined drafts. Accuracy guaranteed.

Free illustrated catalogue on request.

RICHARDSON SCALE COMPANY

Passaic, New Jersey

New York Boston Buffalo Chicago San Francisco

tween four and five hundred times. After about 48 hours' service in filtering liquor, the bone-char is washed with boiling water, dropped by gravity into kilns below, re-burned, and dropped again into coolers and hoppers, ready to be elevated to the tops of the filter tanks for a fresh charge. It will readily be seen that char-handling is continuous, and the conveyors in this building run incessantly, being stopped once a week, only, for oiling. They travel absolutely without noise, form no dust while the char is in transit, and reduce the temperatue of the newly-burned char from 140° to 120° en-route, their length being 90 feet and the lift 110 feet. That these elevating conveyors occupy a minimum of floor space, may be seen by the "close quarters" shown in the accompanying illustrations.

Generally speaking, conveyors of the type used in this refinery, perform the greatest amount of work with the lowest possible up-keep cost, smallest current consumption, fewer and smaller motors, and a minimum amount of spillage—practically nil. They convey their contents noiselessly, without grinding or dust, an accomplishment hitherto impossible with types of conveyors formerly and ordinarily used in plants of this nature. The "sweeping gang" needs to be only as numerous as the police force of Iceland, and at the same time the entire refinery is as clean as a kitchen in Spotless Town! Thus is an unappetizing product of the soil converted into pure white crystal food, and packed, untouched by human hands, into sealed packages to satisfy the most fastidious American housewife.

American Development of the Diesel Engine

(*Continued from Page 11*)

most familiarly known in the automobile today. They owe much of their design to the early gas engine experiments; as a matter of fact, both gasolene and kerosene engines are essentially gas engines—making their own gas from volatile oils.

In connection with the Diesel engine, again, another popular misapprehension prevails. The Diesel was not conceived as an attempt to utilize the heavier oils that could not be used in existing engines, nor was it an attempt to better the performance of other oil engines. As a matter of fact, Doctor Diesel's original design provided for the use of powdered coal as a fuel. The radical departure from existing engines, lay in his plan to compress air to a point where its temperature would be high enough to ignite the fuel; then to admit fuel to the cylinder over a period of about 10 per cent of the piston stroke, so that the heat of combustion would replace the heat lost in driving the piston—attaining what is known as the constant temperature cycle.

The first Diesel engine constructed was made to start with an explosive charge in the cylinder, in order to give the initial impulse. This engine turned over just once, being completely wrecked in the process; an event which considerably dampened the enthusiasm of Doctor Diesel's adherents.

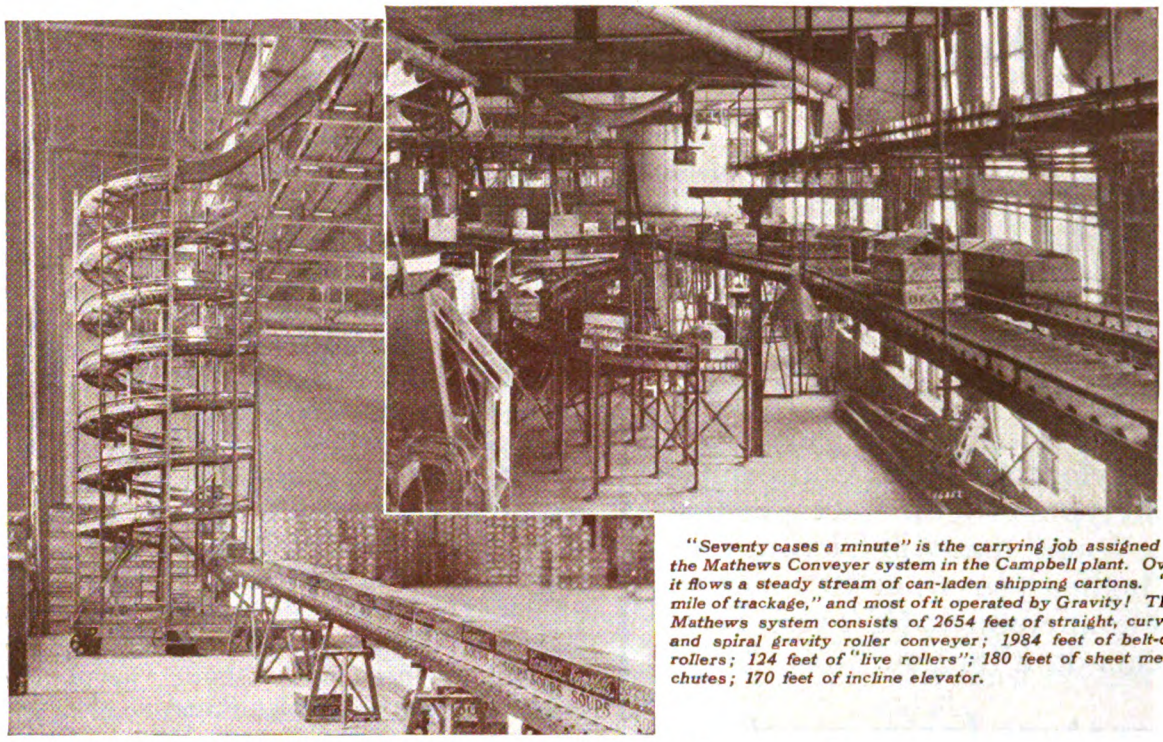
The designers then (in 1893) built a water-cooled engine in which the admission of heat was at constant pressure, instead of at constant temperature, and this engine operated, but generated no appreciable power in excess of that required to keep it going. Development proceeded slowly, and finally, in 1897, a commercially practical engine of 25 H. P. was produced.

It is interesting to note, among the illustrations accompanying this article, the fact that a Diesel engine of 2,000 H. P. has recently been put into service in this country, while in Europe they are al-

(*Continued on Page 56*)

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Parts of the Mathews Conveyer system in the Joseph Campbell Company plant at Camden, N. J.



"Seventy cases a minute" is the carrying job assigned to the Mathews Conveyer system in the Campbell plant. Over it flows a steady stream of can-laden shipping cartons. "A mile of trackage," and most of it operated by Gravity! This Mathews system consists of 2654 feet of straight, curved and spiral gravity roller conveyer; 1984 feet of belt-on-rollers; 124 feet of "live rollers"; 180 feet of sheet metal chutes; 170 feet of incline elevator.

From the cars, through the plant, and back again—via Gravity

THE Joseph Campbell Company is "some tomato" in the canning field. To keep the millions of cases of "empties" coming from the cars, to keep them moving through the plant, to keep them going back, filled, to the cars, is no small problem in production routing and manufacturing efficiency.

For here time counts! A minute's delay, a slight interruption, the least congestion along the line of supply, operation and outlet, means many idle hands; multiplied labor loss; a deep cut into the day's margin of profit.

Today's supply of labor is far too precious—and uncertain!—its cost too great, to be consumed in such non-productive details as carrying or wheeling materials from operation to operation, moving goods to and from warehouse, loading and unloading cars, etc.

Use Gravity! It's free! Harness it! There's work—a job, a place, an operation, a detail—about *your* plant, be it large or small, where Gravity can be used and time, labor and money saved.

Mathews Gravity Conveyer systems can be fitted, section by section, portably or permanently, to any industry, plant, yard or production route. Mathews drawn-steel, ball-bearing rollers are so perfectly balanced and responsive to Gravity that most anything, from fragile objects to heavy crates, boxes, barrels, bags, castings are conveyed gently at very slight inclines and at a moderate, uniform rate of speed.

Do yourself the good turn to look into gravity conveying. Drop us a line. We've a branch office near you, and a sales engineer courteous and willing to go over your plant and problems, point out the economies a Mathews can effect for you, and recommend the equipment your layout and business require—all without any obligation whatever on your part.

MATHEWS GRAVITY CARRIER CO.

122 Tenth Street, Ellwood City, Pa.

Branch Factories: Port Hope, Ontario. London, England

Member of Material Handling Machinery Manufacturers Association

MATHEWS
SPEED ECONOMY
GRAVITY ROLLER CONVEYER

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Tycos

TEMPERATURE INSTRUMENTS

Indicating Recording Controlling

8000 Tycos

This is not the number of *Tycos* users. There are many times more than 8000 users of *Tycos* Thermometers. Eight thousand is the number of styles and types of Temperature Instruments manufactured by Taylor Instrument Companies. Among these 8000 types of temperature instruments one may be found that will fill your particular need. Whether you want to indicate, record, or control temperatures, let *Tycos* Temperature Instruments do it for you.

Tycos Temperature Instruments cover many fields of activity

Farm and Household

Thermometers for bath, cooking and fever.
Hygrometers, Stormoguides, Incubator Thermometers, Dairy and Soil Thermometers.

Out-door life and meteorlogical

Compasses, pocket Barometers, Stormoguides, Rain and Wind Gauges, Auto-Altimeters.

Industrial

Indicating, Recording and Controlling temperature of all types and kinds.

There are *Tycos* indicating thermometers for places wherever a casual glance will be enough, or an index thermometer may be used to bring the reading out of dark corners into light.

There are *Tycos* Recording Thermometers that keep accurate undisputable records. A Bi-Recorder, or superheater will record steam pressure and temperatures on the same chart.

Tycos Temperature Regulators are so accurate they are uncanny in their control of temperatures. Manufacturers know the ability of *Tycos* Temperature Instruments to withstand the strains and knocks of every industry.

If you are interested in any of the above fields of activity, signify your interest in any of the above fields of activity and we will gladly send you informative booklets upon any subject. Industrial operators are invited to send for our general industrial catalog.

Taylor Instrument Companies

Rochester, N. Y., U. S. A.

There's a *Tycos* and *Taylor* temperature instrument for every purpose

(*Continued from Page 54*)

ready working on units as high as 10,000 H. P.—quite an advance over the 25 H. P. engine of twenty-five years ago, and a very good exposition of the remarkable growth and perfected development of this highly efficient engine.

The Diesel engine differs from the gasolene engine in several fundamental respects: it is essentially a high-compression engine, in which only pure air (not the fuel charge) is compressed to some 480 to 550 lbs. per square inch, this compression itself raising the air temperature to about 1100° F. The fuel is injected through an atomizing valve, and is ignited (not exploded) on contact with the heated air; in other words, the temperature produced by compression is the means of igniting the fuel, without the need of hot bulb, hot plate, electric spark, or any other device. Lastly, the fuel oil continues to be injected during about 10 per cent of the working stroke; the "slow-burning" character of the combustion giving a steady push, rather than a sudden kick, to the piston. (Reference to the drawings on page 8, will help to make these points clear.)

Where gasolene engines are restricted to the use of gasolene, or gasolene and kerosene, the Diesel operates successfully on the much cheaper heavy oils and even on some of the crude oils as they come from the well, besides being able to utilize the heavier oils obtained from by-product distillation of coal. In other words, the Diesel engine as a prime mover offers all the advantage of low-compression and semi-Diesel engines (as outlined in "The Direct Route from Fuel to Power," *Industry Illustrated*, November, 1922) plus the additional advantage of a wider range of fuels, the ability to operate economically under varying loads, and the ability to operate without rest periods. Last and most important of all, the Diesel operates with an overall efficiency of from 32 per cent to 33 per cent, as compared with an overall steam plant efficiency of from 16 per cent (in the most up-to-date and efficient central power stations) to 7 per cent—the latter being a fair average for industrial steam power plants in this country.

With all these points in its favor, the growth of Diesel engine operation in this country has been extremely slow until very recently. Only in the last five years has there been anywhere near the recognition that this engine merits; and only in the last two years has there been a growth in the number of Diesel operated plants, commensurate with the demonstrated possibilites. Germany, Switzerland, Russia and England, before the Great War, were far in the lead; the United States, up to that time, had—industrially speaking—little interest in the subject. And it is only by sheer, demonstrated merit that today the Diesel is beginning to take its proper place in our power field.

As the Diesel has been perfected to its present state of development, its potential field has at the same time become more clearly defined. Predictions that it never could displace steam plants of large size, and predictions that it would entirely supplant steam, have both proved wide of the mark.

There are a number of industrial plants which require a large amount of steam in their processes—where, as a matter of actual fact, power is almost a by-product of the essential steam. Again, there are many plants whose power requirements call for an installation of less than 150 brake horsepower. Lastly, there are plants which (like the River Rouge plant of the Ford Motor Company) are able to link up their power units with coal-distillation and blast furnace units. In none of these would the Diesel engine in its pesent state of development prove economical.

When we come, however, to the large class of power plants—both central station and industrial—where units of from 150 H. P. to 2,000 H. P. are required, and where only small quantities (or none at all) of exhaust steam are needed for processes, the Diesel engine has proved its right to contend with any other kind of motive power on the score of economical power production. If we consider a more closely limited field—say, between 200 and 1,200 H. P. units (with the

(*Continued on Page 58*)

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Side by side you find them

Performance of one leading to the purchase of another

The Fulton-Diesel has won the highest endorsement that can come through tests in service. In one case after another where there was a Fulton installation and additional horsepower was needed, another Fulton-Diesel was bought.

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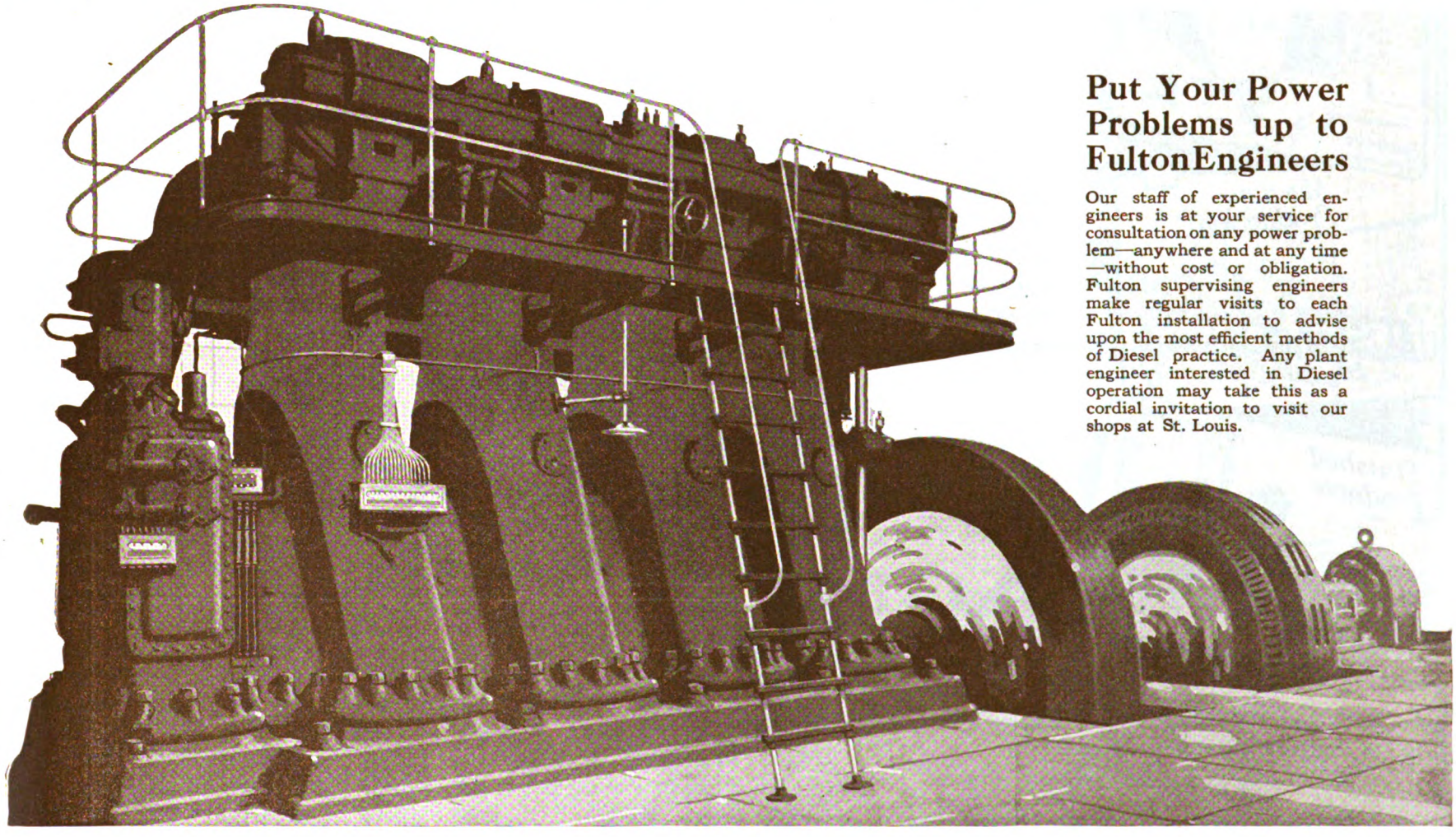
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(*Continued from Page 56*)

same low requirements for process steam)—the Diesel has demonstrated its superior economy over steam plants in any number of cases. In units below 150 H. P., the fixed charges per horsepower may be relatively so high as to outweigh the better thermal efficiency over steam power. Above 1,200 H. P. units, again, additional economies in steam plant operation become possible, and at the same time the higher cost of installation of the Diesel over the steam plant makes for increasingly high fixed charges as the power rating increases. This factor, however, is becoming less with the passage of time, as evidenced by the increase in size of Diesel units. So, broadly speaking, the logical, indisputable field for the Diesel engine at its present stage of perfection, lies in the plants of between 200 and 1,200 horsepower which require little or no process steam. In higher powers, individual conditions must determine between Diesel and steam; where large amounts of steam are needed, both Diesel and oil engine are eliminated; and between 150 and 200 horsepower, again individual conditions must determine between steam, oil engine and Diesel engine.

Prior to 1912, there were but one or two manufacturers of Diesel engines in this country; Adolphus Busch, of St. Louis having organized the pioneer company operating under license. In 1912, however, Doctor Diesel's patent protection expired, and from then on an increasing number of American manufacturers undertook the building of this type of engine; until today there are a score or more different makes of American-built Diesel engines.

Taking the country as a whole, a survey made by *Power* showed that there were, in March of last year, some 1227 Diesel engines in operation in stationary plants with a total rated horsepower of 292,673. Of these, about one-quarter are in central station service, and slightly more than one-quarter are on oil pipe lines. The balance are distributed among mines, quarries, ice plants, cement plants, chemical industries, water works (irrigation), flour mills, machine shops and miscellaneous other industries. And, where there were 1227 Diesel engines in operation less than two years ago, today there are more than 1500, with the number growing rapidly.

Having begun this discussion with figures, it is no more than fitting that we close it in the same way. The following table was compiled from the records of a Diesel engine power plant which replaced steam equipment, and is a typical example of actual results. In this plant a 500 H. P. engine was installed in January, 1919, and in August, 1921, a second unit was installed to take care of increased demands.

January, 1919—December, 1921

Year	K. W. H. Output	Gallons Fuel Oil	K. W. H. per Gal.
1919	1,522,300	119,932	12.7
1920	2,176,800	163,021	13.35
1921	2,344,785	192,979	12.1
Total, 3 years	6,043,885	475,932	
Average Efficiency.....			12.7

It will be noted, by those conversant with Diesel engine manufacturers' guarantees, that this fuel oil efficiency is in excess of average guarantees—and this merely bears out the often-proved fact that these guarantees are usually conservative.

The oil dollar, then—reverting to our original comparison, and taking the average present-day fuel oil price—buys 476 brake-horsepower-hours in this Diesel engine plant. The coal dollar, in a plant getting 7 per cent overall efficiency, and assuming that we get a high-heat-value coal, buys but 171 brake-horsepower-hours.

Obviously, it would take a good deal of excess maintenance charges, installation charges or any other charges, to overcome this difference in fuel cost per horsepower-hour. Especially when we realize that sixty-five per cent. of the operating cost of a steam plant is the cost of coal.

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Cutting All the Teeth of a Gear at Once

(*Continued from Page 15*)

train. The machine is seven feet high, weighs 17,000 pounds and when operating to full capacity is driven by a 100 H. P. motor. Its capacity is for gears 12 inches in diameter, 6 inch face, 4 diametral pitch.

The tool head consists essentially of a flat, steel disc 3 feet in diameter, provided with a hole at the center and a number of radial grooves cut in its face, in which the tool bits are arranged like the spokes of a wheel about the circumference of the gear. Successive feeding movements are imparted to the tools by an annular sectional cam ring. As the gear blank is reciprocated past the cutting tools, the tools are gradually fed in by successive cuts to the full depth of the tooth. At the completion of each stroke of the ram and before the next cut begins, the gear blank is indexed a space equal to one tooth, thereby presenting a different tool to each tooth from the one which made the previous cut. After the tools have been fed in to full depth, they are held stationary in that position while the cutting process continues until the gear has indexed one complete revolution thereby giving each tool an opportunity to take one last cut on each tooth. This final complete index insures a uniformity of spacing of the teeth in the gear equal to that of the indexing mechanism. Uniformity of the tooth form is secured even though the tools themselves may be far from uniform, for it is at once apparent that if any tool is longer or wider than any other tool, even though it be only a thousandth of an inch, that portion of it which is longer or wider will take one last cut on the corresponding portion of each tooth in the gear, thereby eliminating any variation which may have been caused by previous cuts. By this process of finishing all the teeth of a gear with a single finishing tool, this machine attains great accuracy and the speed is multiplied by the number of tools operating on the gear blank at one time.

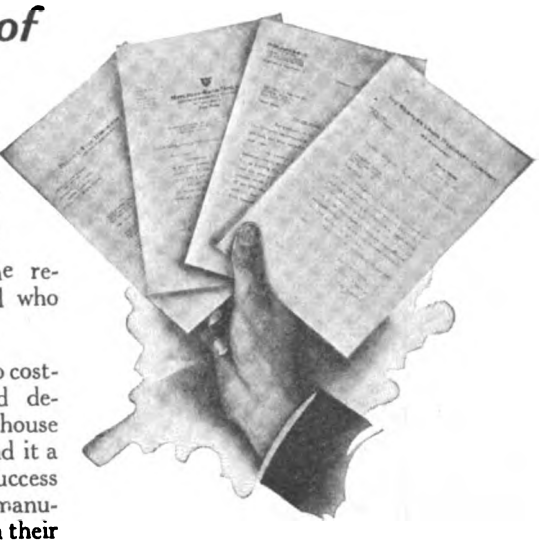
To technical men the most interesting individual mechanism on this machine is the tool head, as it involves the solution of the most interesting and important problems, both in design and construction. In the two illustrations of the tool head, the left-hand view is a top view of the tool head as it would appear when in operation on the machine; while the cut at the right shows the tool head partly disassembled and shows the principal details of the mechanism. When it is mounted on the machine, the only working parts to be seen are the points of the tool bits surrounding the gear blanks and the small depth adjustment dial seen in the upper part of the illustration. The four pairs of T slots seen in this illustration are for attaching a piloting device which is used on extremely long and slender arbors which may need an outer support. Two tool heads are provided for each machine and while one is in use on the machine, the tools of the other are being sharpened and re-set ready for use after the tools in operation begin to dull. The tool head is held in place by 8 studs and nuts shown in the illustration. When it is desired to set up a new job or to sharpen the tools, these 8 nuts are taken off and the tool head is lifted off of the machine bodily and is re-placed by the other tool head. This arrangement permits the machine to operate practically continually with very little loss of time on account of set-up and sharpening tools.

The tool bits shown are rectangular in section except the lower side which is in the form of a "V." The gear tooth profile is formed at the inner end of this tool and is backed off to permit sharpening without changing the form. The outer end of this tool rests against a spiral cam surface and is ground in the form of an exact radius. A small pin near the back end fits in a groove which has an opposing spiral surface and retains the tool in close contact with the other cam surface to insure correct contact at all times as well as to withdraw the tools to their

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State of New York, County of Otsego, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. R. Dunlap, Jr., who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Industry Illustrated and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of publisher, editor, managing editor, and business managers are: Publisher, The Engineering Magazine Co., 120 West 32nd St., New York City; Editor, John R. Dunlap, 120 West 32nd St., New York City; Managing Editor, John H. Van Deventer; Business Manager, J. R. Dunlap, Jr., 120 West 32nd St., New York City.

2. That the owners are: The Engineering Magazine Co., John R. Dunlap, J. R. Dunlap, Jr., J. H. Van Deventer, Rutledge Bermingham, and Walter Ives.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bonafide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

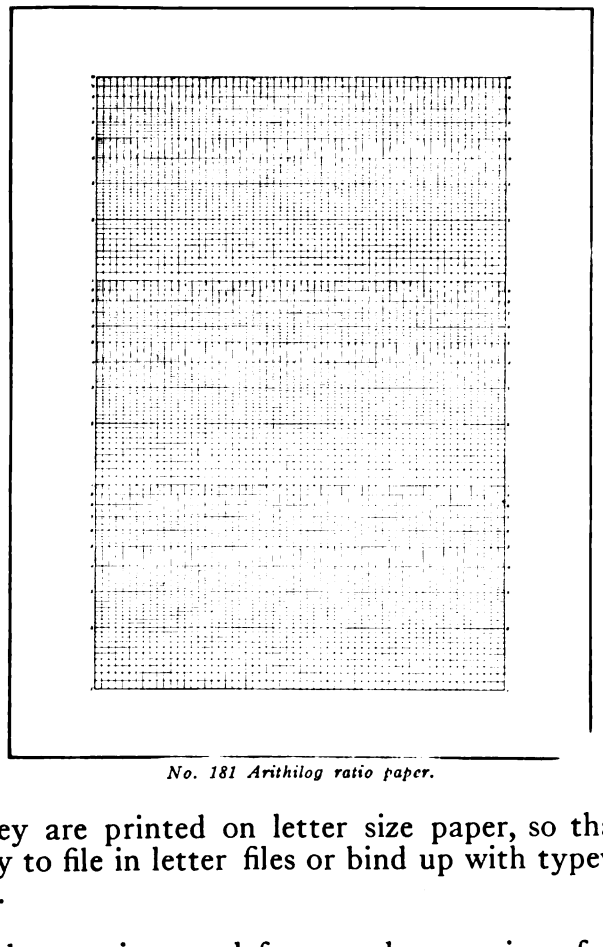
J. R. DUNLAP, JR.,
Business Manager.

Sworn to and subscribed before me this 11th day of October, 1922.
(Seal.) CHAS. R. GOETZ.
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starting position after the cut is finished.

The individual cam lugs are mounted on a large ring which encircles the tool bits and spacing plate and are held down by T bolts which fit in a circular T slot in the ring. The tool bits are adjusted for depth independently by moving these cam lugs individually along the T slot relative to the cam ring and each other. Simultaneous feeding movements are imparted to the cam ring through the two idler gears seen in the lower part of the tool head, and are produced by a feed mechanism which will be explained.

The final depth to which the tools are fed is determined by an adjustable stop which positively limits the rotary feeding movement of the cam ring. This feed mechanism being spring actuated, the position of the depth controlling stop can be varied within reasonable limits without re-setting of the feed mechanism. This is particularly desirable during the operation of the machine in cases where the tool bits may not have been set to exactly the right depth in the beginning or in cases where the keen edge wears off of the tools and they begin to cut gears that are uneven or oversize long before they are actually dull. The dial which controls this adjustment can be reset within less than a minute's time whenever the operator desires.

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The work arbor used in this machine, as shown in the lower left hand illustration on the opening page, is provided with a taper shank and thrust collar and fits the tapered socket in the ram spindle. The thrust collar prevents the taper shank being thrust too tightly into the socket. The gear blanks are put on the arbor and fastened in place by a nut while the arbor is held in a

(*Continued on Page 62*)



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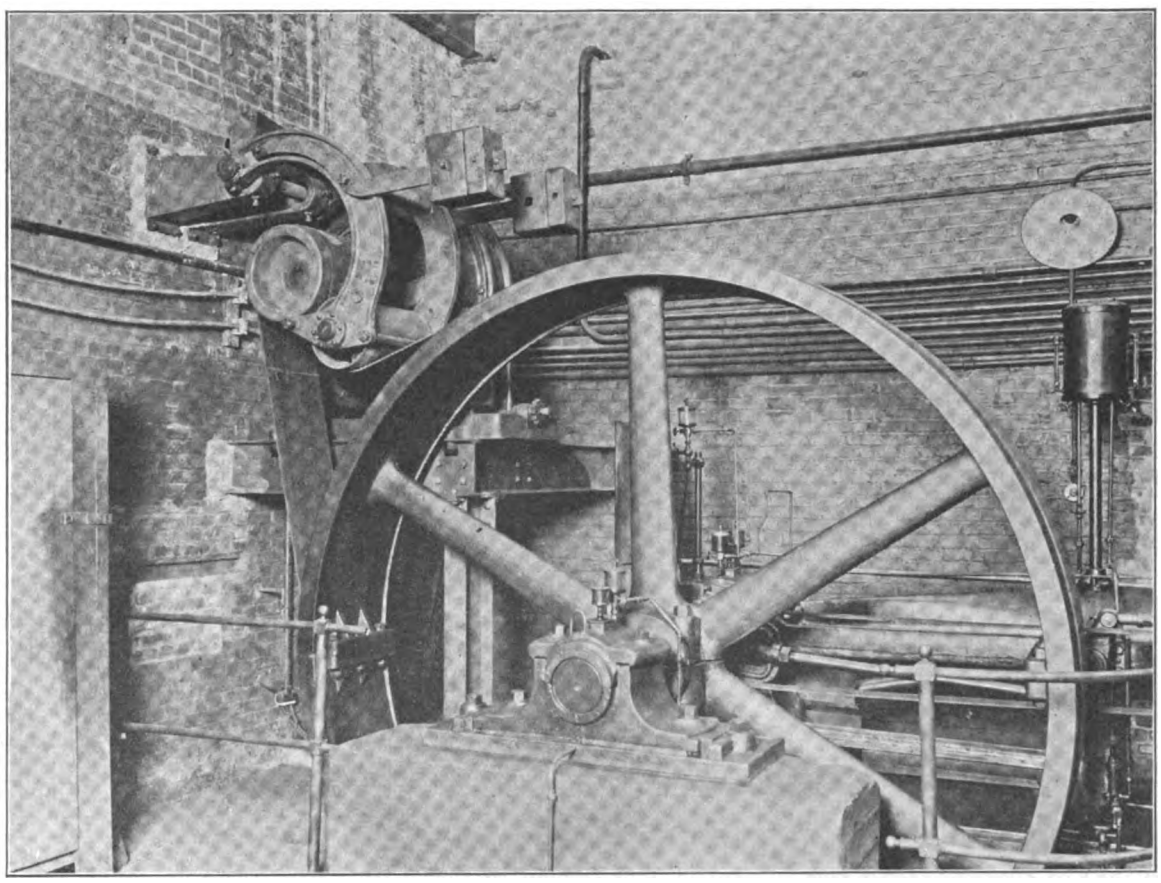
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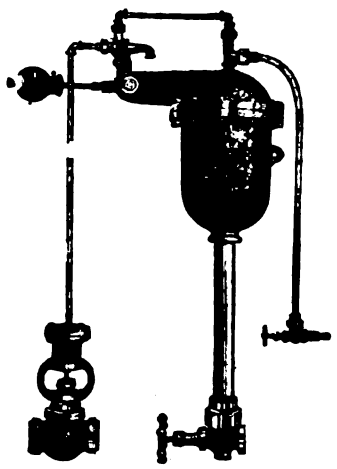
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(Continued from Page 60)

vice like fixture attached to a bench at the side of the machine. After loading the arbor it is then dropped into the taper socket in the ram spindle and the machine is ready to work. The thrust of the cut forces the taper back into the socket until it strikes the shoulder of the arbor. The tight fit of the taper is sufficient to prevent the arbor from turning under the pressure of the cut but is not sufficient to make it difficult to remove. While one arbor of gears is being cut, another arbor is being loaded with blanks. As soon as the arbor in the machine is finished, the operator holding the arbor of un-cut blanks in one hand, stops the machine, presses a conveniently located foot pedal which by means of a long kick-out bar passing through a hole in the center of the ram spindle, knocks out the arbor of completed gears, and catches it in the other hand. He then drops the arbor of un-cut blanks into the open socket, touches the starter button and the cutting operation again proceeds almost without interruption. The entire operation of stopping the machine, of clanging the arbors and starting again, occupies less than one-half minute.

If it were necessary to remove the nut and change the gears on the arbor in the way that is usually done on other gear cutting machines, the machine remaining idle in the meantime, it will be realized that it would make a very material difference in the amount of production from the machine, when it is remembered that the total time of completing an arbor of gears ranges from one to three minutes.

The tooling up of a job on the multiple shaper offers unlimited opportunities for the exercise of ingenuity on the part of the set-up man or tool designer, both as to variety of the tool bits and their arrangement. In cutting some gears, it is desirable to use as many tools as there are teeth in the gear. In others it is more practical to use only half or a third as many tools as there are teeth. In an arrangement of this sort, a tool head equipped with any number of tools could cut gears having any number of teeth which is a multiple of the number of tools used. Thus a spacing plate having 10 tools could be made to cut 10, 20 or 30 teeth, etc. In a case like this, if it is desired to cut a number of teeth greater than the number of individual tool bits which can conveniently be placed within the space, a gang tool bit is used in which each tool cuts two or more teeth. This arrangement is particularly advantageous in cutting gears having a large number of very fine teeth, on account of the fact that although the amount of power required for the cutting of all of the teeth is very small, it would nevertheless be practically impossible to use as many individual tools as there are teeth in the product. Where it is desired to cut a gear having an odd number of teeth and it is not practical to use a tool for every tooth, as in the case of a 29-toothed gear for example, ten tools might be used. Nine of the spaces between tools would be equal to 3/29 of a circle each and the 10th space equal to 2/29. While the service on one tool would be slightly less than that on each of the other 9, the difference would be scarcely appreciable. In some cases, it is desirable to make every other tool in the form of some sort of a roughing tool, either a square-nose gashing tool or a stepped roughing tool of the usual type and so adjust them that they will remove most of the stock from the tooth space. The alternate tools are then made in the usual type of finishing tools and take the last few finishing cuts. At other times, a special cam is provided for one tool, so that this tool is held back during the stock removing cuts and is then suddenly fed forward ahead of the other tools to take the finishing cuts on all of the teeth. These various arrangements are merely suggestive of a few of the possibilities in this line. An unlimited number of possible combinations will suggest themselves to tool designers and set-up men acquainted with this line of work.

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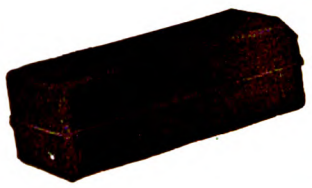
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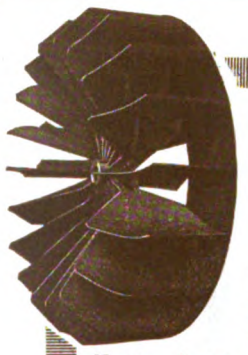
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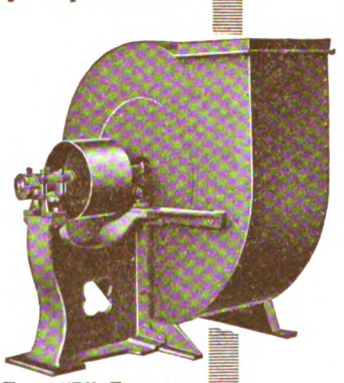
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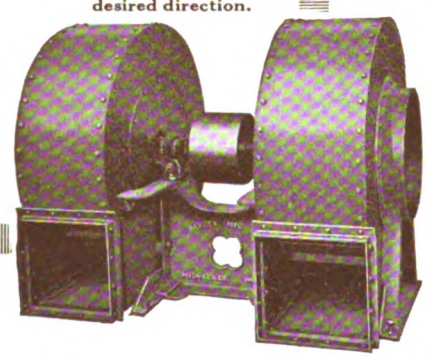
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Graphics as a Production Stimulant

(*Continued from Page 18*)

Graphic methods of scheduling production and of following it up are employed to cope with this problem. They are in general similar to the graphical methods used in the other Westinghouse plants, and have been developed to a high degree of simplicity and effectiveness.

The controlling charts such as you may see on page 16 at A are combination monthly accumulative and current output quota charts drawn on ordinary cross section paper. The straight unbroken lines which are in red on the original charts represent the established quotas. As the month proceeds the actual performance record is superimposed so that at a glance it is possible for the production manager to see just how requirements are being met for any one size or variety of motor. One of these control charts is made out for each shop or special order or in other words for each type and size of completed article in production.

While these charts serve as the principal means of follow-up they are individually, when required, split into groups of *component part charts*. Thus an order for standard motors may be split into frames, field windings, armatures, shafts, etc. This enables the detailed following up of such parts as may be delaying the completed assembly, and this splitting up is used when and as required. In other words, if a control chart shows that the cumulative production fails to touch the quota line, subsidiary charts are at once made in order to remedy the trouble. These charts are of the same type as the control chart first mentioned.

The use of these charts is not by any means confined to the management. To do so would be to fail to take advantage of a well recognized principle that all employees work better when they can see their "score" plotted from day to day. In the principal manufacturing departments therefore, are bulletin boards such as shown at B on which are posted a set of the control charts covering the work of each department. Thus the foreman, department clerk and the workers in each department are informed at all times as to whether or not they are keeping up to the established quotas.

The use of this graphic stimulant to production is even carried a step further. In walking through the plant one notices small operation progress charts posted here and there at various machines or assembly benches. Each of these charts covers one operation, being of even greater detail than the subsidiary charts which cover all of the operations on one of the parts going into the assembly. In each case where such charts are posted, as shown at C it means that the operation at that particular bench or machine is either behind quota or needs watching to keep it up to quota. Usually very little is required to secure the desired re-

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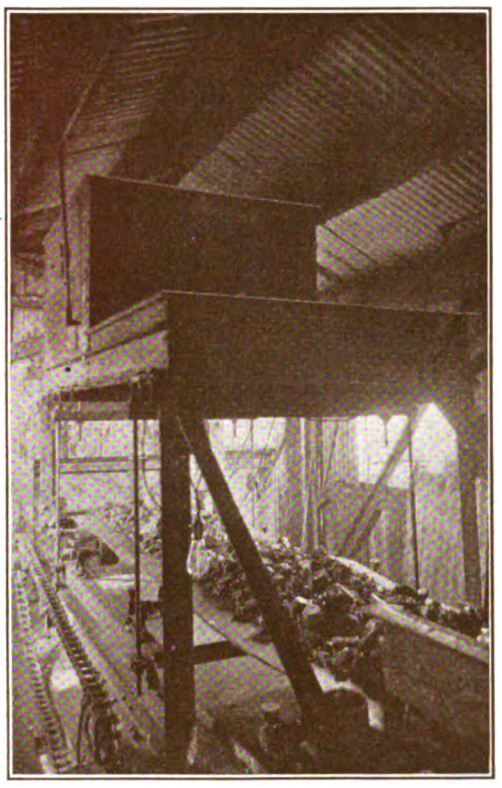
sults other than the mere posting of one of these charts. When conditions require it, the progress is sometimes checked up hourly.

The use of this quota method of charting and following production is based on the principle of establishing *rates of production* for each order, whether this be a special order or a shop order for standard motors. To make sure that in the latter case the required delivery dates of shipment are being made on customers' orders, a further step is necessary. This is because a manufacturing quota or rate may be satisfactorily maintained and yet without assurance that the required priority of shipment is secured. A simple, yet ingenious, plan takes care of this point. This consists of giving every order, whether special or shop order, a required date of completion. If it is a special order this date is of course a day or two prior to the date of shipment promised to the purchaser. If it is a shop order the date of completion is the end of the month and the quantity is the monthly quota. Records are kept for each department, known as delayed order efficiency records. Thus if there are ten orders in a department during a given month, five of which have been completed on time and five of which are behind time, the efficiency of the department is fifty per cent. Thus in order to maintain its prestige in the eyes of the management a department must do two things; first, its quota control charts must show that the scheduled rate of production is being maintained; second, it must stand well in the matter of delayed orders.

That such a simple plan as this works so well under such difficult conditions as represented by the production undertaken at East Springfield, is an indication that it ought to work admirably where similar conditions are encountered and where red tape is not prized for its complexity.

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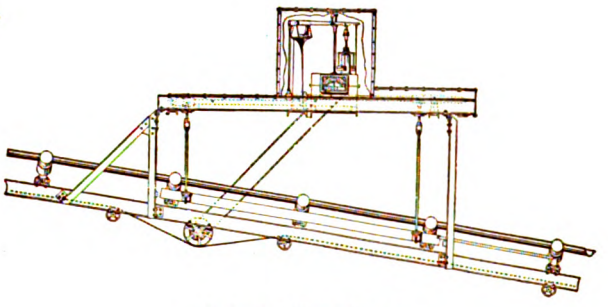


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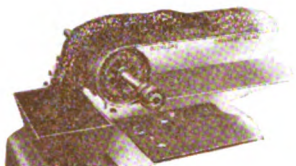
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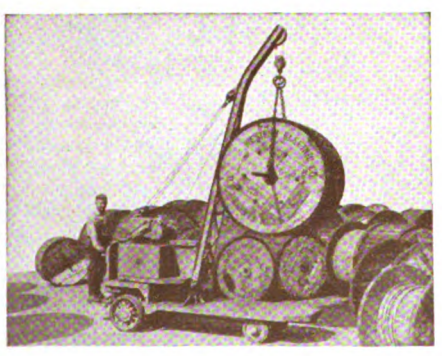
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HANDLING

Getting Out from Behind the Horse

(*Continued from Page 19*)

that started him. Before he was sixteen he had such a fair working knowledge of the subject that he had devised an apparatus which made oxygen gas, and constructed it out of materials such as he could find in a little town where there was not a piece of glass tubing to be had, for example. He was not able to get to college until he was twenty-one years of age, but the equipment available to him at Worcester Polytechnic Institute was like a rare instrument to a musician. Instead of pottering with set experiments he did original research work, and did it on such lines and so effectively that he discovered or invented tungsten steel and made that alloy the subject of his graduating thesis. He went on experimenting until he was making a number of steels in combination with nickel, chromium and other rare metals. Pigeonhole that fact for a few minutes until the story goes a little farther along, and see how Haynes, by pursuing one line of study and work, got cumulative dividends out of it.

He quit teaching in 1886 to become, first, manager of a local natural gas company, and then field superintendent of a larger company which was to supply Chicago with natural gas. The things he ran against in this new business, some people would have called obstacles, or at least difficulties. With Haynes, they just served to start his inventive faculty into action. Of course, there were delays in constructing the long pipe line. Then, when it finally was finished, in a few days it froze up with the moisture contained in the gas. Haynes settled that by simply playing Nature's own game, but in his own way. He built a refrigerator, ran the gas through it, and froze the moisture out of it before it was turned into the pipe line. Then he devised a pressure regulator. And a vapor thermostat to regulate the temperature of a room heated by natural gas.

"Construction of the Chicago pipe line began late in '89 and took the best part of a year to complete," said Mr. Haynes. "Naturally I had to do a great deal of driving up and down the line. I don't know just when it was, during those long drives, that I got to thinking how much time it wasted, to have to sit behind a horse hours and hours every day; how slow and how lacking in endurance the animal was; and whether some kind of a mechanical vehicle could not be contrived to take his place. The long drives, though, did have one advantage just at that time. They allowed me plenty of time for thinking, and my mind pursued that line of thought more and more definitely. I weighed the possibilities of steam and electricity as the motive power for such a vehicle, eliminated both of them, and decided the necessary power could be supplied best by a gas engine.

"That much being definite in my mind, I made a decision. For the second time I quit a good job, and set myself to studying, planing, drafting, experimenting for nearly two years. In 1892, having completed a set of plans which looked as if they might work, I moved to Kokomo, where the Haynes automobile business has been located ever since. It was not until late in 1893 that I began the actual construction of my first vehicle by buying a one-horse power two-cycle marine gas engine. I used the marine type because, for the same power, it was a lighter engine than the stationary; and also it was constructed with a view to operating conditions more nearly like those to be encountered in a moving vehicle, since it was built to be used in a moving boat. I built this first machine with a one cylinder motor, ball bearings and pneumatic tires. Instead of setting the motor over the axle, the modern chassis was anticipated by suspending in a special frame of its own. The result was that I had a machine weighing altogether 820 pounds which, in every essential was the modern automobile, and was the first American car to get beyond the experimental stage and meet the conditions of actual use.

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"It was on the Fourth of July, 1894, that this car was given its first road run. I had a horse pull it from the shop about three and a half miles. Then I drove it a mile and a half farther, I stopped, turned around, and drove the five miles back to town in a little less than an hour. Of course, it made a sensation—several sensations, in fact, ranging all the way from derision to amazement and fright. The Smithsonian Institute now has that pioneer "horseless carriage" among its exhibits in Washington.

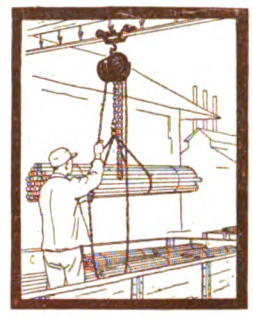
"Although the machine had proved it could run, I continued my experimental work for four years more before I felt the machine had reached the point where it was ready for manufacturing and marketing. My work on steel and other alloys stood me in good stead here. In 1895 I made the crank case of aluminum. Then I used nickel steel for the axles. With the 1895 car I drove to Chicago to take part in the race promoted by the Times-Herald. My trip was chiefly remarkable, as I look back on it now, for the fact that a policeman ordered me off Michigan Boulevard! I wonder if he remembers it as I do.

"In 1898 the Haynes-Apperson Motor Company was organized, and has been in continuous existence ever since, though the Apperson brothers left four years later, so the company has since been known as the Haynes Automobile Company. We decided to make fifty cars the first year. Then we hearl that a competitor was going to make 100 cars and we were worried with fear that the United States might not care to buy 150 cars. Our fears were groundless, however. Five of our machines were taken for use in Porto Rico on the mail routes. I myself delivered a car we sold to a Brooklyn physician, driving it the thousand miles across country, a feat which attracted a great deal of notice. The trip was made at an average speed of fourteen miles an hour. That's a couple of miles per hour better than the stage coaches used to make from London to Brighton in Dickens's time.

"From that time on, it has been a case of steady development. We were the first to break away from the horseless carriage idea and build a car that was a motor car, and not merely a carriage with a motor instead of a horse. It takes a while, you know, for our minds to make those transitions from old forms to new. Gas stoves were built like coal stoves for a long time, with the ovens down below, just because they always had been there, until it occurred to somebody that they didn't have to be there, but could be up on top, in a more convenient position. In several other improvements we pioneered, like electric ignition, the magneto, the throttling carburetor, a double set of spark plugs, and the jump spark."

Even during the years of development of the Haynes automobile and of a great manufacturing business to put it on the market, Mr. Haynes, has been the scientist and inventor in other lines. Steel alloys seem to be a hobby with him, for as recently as 1919 he received a patent for "stellite," or stain less steel, which he had invented in 1911. A rotary gas valve engine is another of the incidental products of his genius. That he is something more than a manufacturer is evidenced by his membership in several of the great scientific societies here and abroad. Hale and hearty at sixty-five, Elwood Hynes is a splendid example of the strenuous, creative American. "I did not develop the automobile, nor have I ever worked out any of the other things I have undertaken, as a commercial enterprise primarily. Just as I got thinking how slow it was to sit behind a horse and depend on his limitations for carrying out tasks that were no concern of his, so I have always done these things for the sake, first of all and most of all, of serving men's necessities or convenience. Of course, to produce the things that people need or want, in quantities that will bring the cost within reach and to distribute those things to the greatest number of people, who need them or want them, is business, commerce. And in order that business shall not stop its functioning, it must be, and has a right to be, profitable to a reasonable extent. But the profit is not the reason, to my mind, for the existence of the business."

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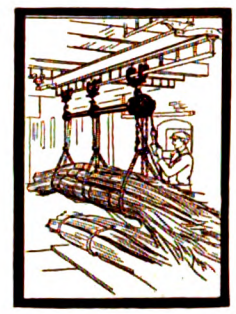
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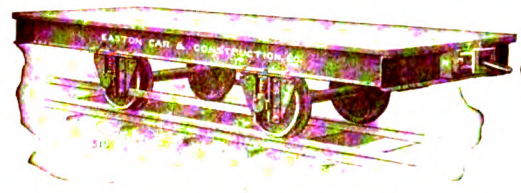
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HANDLING

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MATERIAL

"Handling" is the wrong word



when applied to Dow Conveyors. *Handling* suggests *carrying by hand* whereas the very purpose of Dow Conveyors is to dispense with costly human effort in moving parts and finished products from one place to another. Dow Conveyors (Gravity and Power) do away with porters and enable the skilled mechanic to devote *all* of his time to production instead of intermittently walking the floor. Many manufacturers are not aware of the time-labor-and money-saving ability of Dow Conveyors. The facts are yours for the asking. The Dow Co., Incorporated, Louisville, Ky.



DOW CONVEYORS

LEWIS-SHEPARD means LABOR SAVING

in Material Handling Equipment

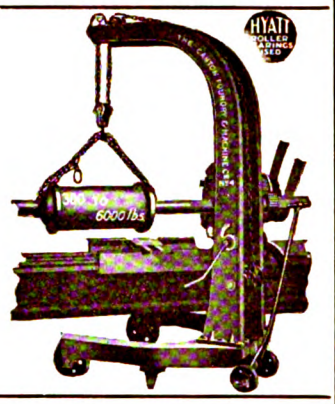
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With the January issue the rate for space in this section will be $20.00 per advertisement. We are offering these until then at 18.00 per month.

This small announcement will absolutely pay you in big dividends and will secure from INDUSTRY ILLUSRRATED'S 20,000 executive readers ad attention far out of prortion to its cost.

Copy for the January issue can be received up to Ddcember 14th.

SEND IT IN IMMEDIATELY

Advertising Department
INDUSTRY ILLUSTRATED
120 West 32nd Street
New York

HANDLING

When One Department Has th "Backing" of the Others

BY L. E. DIX

A foreman of this plant read a paper at our last meeting in which he made the following appeal to his brother foremen:

"Our aim is to have the good will and confidence of every foreman in the yard. You here, and most of your men are fully experienced in your work. Being a new department we are not as experienced in our work, and seek your co-operation and aid in making our work of the utmost value. Help us to help you."

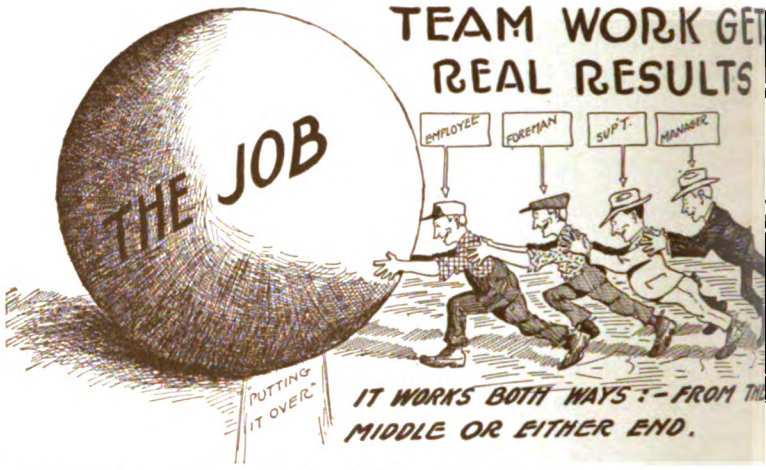
In these words this foreman voices the desire of every foreman interested in the growth and success of his company and therein is signified an obligation, the fulfillment of which is the master key to harmonious operation.

In trade for service a foreman must give service, as service is the medium of exchange by which the ultimate purpose of his organization is carried forward to its goal; profit for his company.

When a new department is established or a man placed on some special line of work and the work is not followed up closely, and the man in question does not receive the concentrated "backing" of every other person working toward the same point, the objective is hampered and they are "milling around" so to speak.

Those who criticise any movement for efficiency or improvement are not really obstacles—not enemies at heart—they are simply snapping at the heels of progress.

The manager's office is helpless without the "backing" of his superintendent. The superintendent's office is worthless without the "backing" the foremen and the fore are powerless without "backing" of one another of their men. And, reve this outline it can so we proven that the men are without the "backing" of foreman, the foremen are less without the "backing" the superintendent and th perintendent will "fall de without the "backing" of



manager.

Now in transferring subject of "backing" talents and ability of vidual employees, there out many advantages gained by a study of th ter by foremen, and wh foreman discovers a special talent or abilit takes it upon himself to that this employee's kn edge and competency passed on to another fore who in turn brings out th most in productiveness in man's work, the one for is "backing up" the oth the true sense of the wor

When a foreman o work through another man and sees that this pie work is clearly outlined, the equipment in questi prepared and ready for work to start, and whe avoids delays or mistake keeping an eye on the job when the foreman whose are doing the work follo considers the desire of other foreman, we have an ample of "backing" that not fail to produce.

The effect of support evident in manufacture as in sport and the defeat unsupported pitcher in game is proverbial.

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Every foreman is a pitcher the manufacturing game. e is there to win his game id as he endeavors to put ome advantageous effort rough in his department he ust be "backed" by his field, e other foremen, who each turn sees the time come hen he must step into the tchers' box—where he wants feel that surrounding him—ack of him—are the men who eally are the key to the situa-on and with the assurance of eir support his energy and bility are formed into that ing for which every commer-al organization is operating -profit.

A foreman is provided op-ortunity to see efficiency rough the recognition of in-fficiency. Some system or ethod is failing or requires a ifferent application. When e endeavors to make the de-red connection along these nes the occasion is offered hereby he may "lay his cards n the table" by presenting ne facts or faults and prove is worth in a substantial man-er. A frank "I don't know," I'm up against it" or, "I eed help" is worth a lot more oney than an attempt to pro-eed under some failing sys-em.

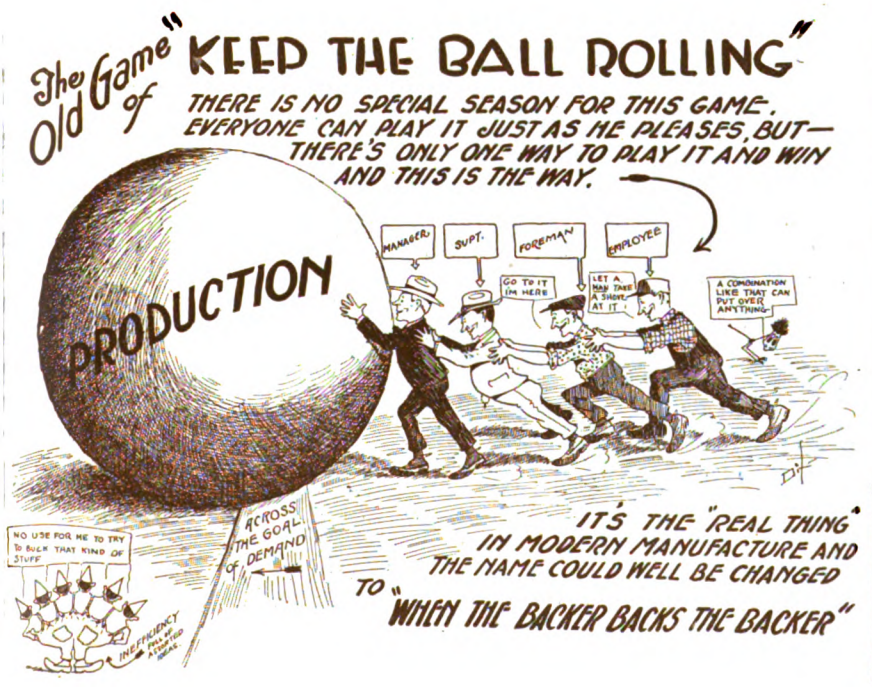
Frequently a case demands mmediate action. It may re-uire some thing unusual. The oreman may have to step out f his fixed jurisdiction in the nterest of something that neans time and money to his ompany.

A matter of this kind is very imple yet constructive if all oncerned are looking at it in he big way—the way that leaves personal distaste or wrong opinion. Every organization of this kind commands the unqualified "backing" of its foremen individually and collectively.

Fortunately the foreman of a department has occasions to make suggestions favorable to some other department, but he is cautiously or timidly, or, we might say, foolishly considerate. He is afraid his ideas may not be welcomed. As a matter of fact, ambitious foremen are on the lookout for good ideas, regardless of the source, realizing that it is impossible for one man to grasp every phase of any given situation. Now when these two foremen get together—when each understands that it is as much to his individual credit to obtain these suggestions from other foremen or from the men under him—to cast about himself the receptive relationship that encourages these little helps—then is created that "backing" which gets what we're after.

It is along these lines that any group of foremen can be moulded into a combination of strength and soundness, the foundation of which is faith in one another, and structure of which is support of one another.

Impelled by the forceful influence of "backing," every foreman devolves into a powerful unit of accomplishment. Working alone he flounders—is stagnant—unproductive. "Backed up," he creates,—builds—produces and shares, in the satisfactory returns which are sure when all are for one and one is for all.

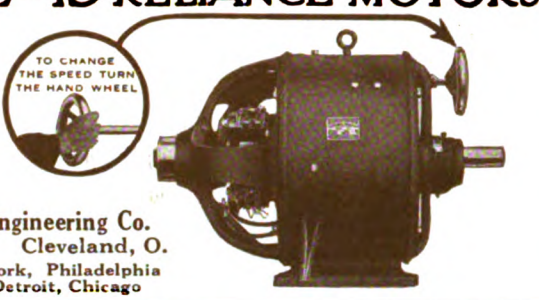


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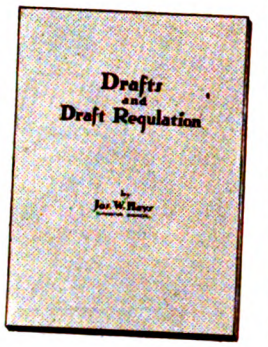


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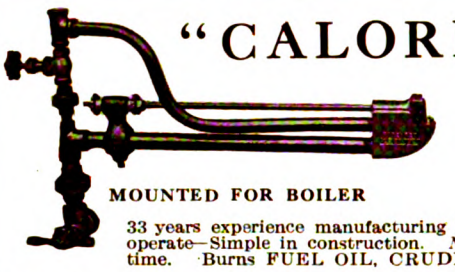
An Interesting Booklet for the Asking



The greatest cause of fuel waste is faulty draft regulation—too much excess air diluting the gases of combustion and cooling the heating surfaces. Mr. Hays' treatise on "Drafts and Draft Regulation" contains a fund of sound, practical information on this important subject.
It also describes and illustrates various types of Hays' Draft Gages, which rugge instruments are designed especially for use in the boiler room.



The Jos-W-Hays Corporation
Combustion Efficiency Appliances
Michigan City, Indiana

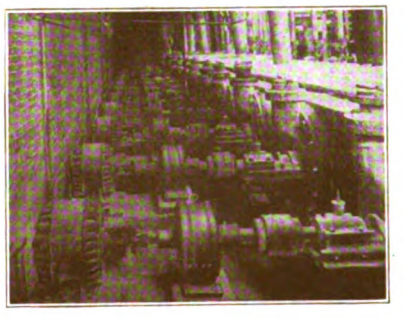


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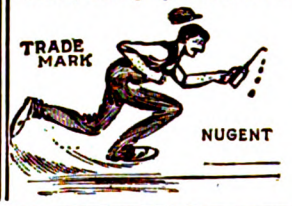
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We are the largest and oldest Company in the United States that manufactures Oil Filters, Oiling Systems, Telescopic Oilers, and Oiling Devices exclusively.

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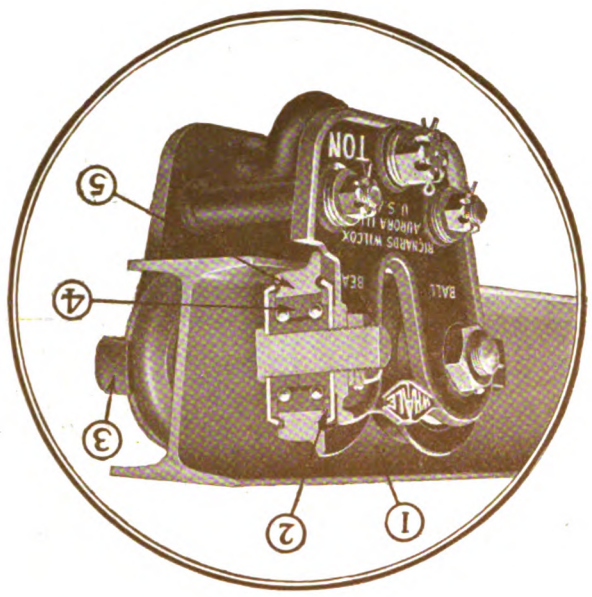


WM. W. NUGENT & CO.
410 N. Hermitage Avenue, Chicago
Established 1897

EQUIPMENT

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"Yale" Swallows "Whale"



THE Yale & Towne Manufacturing Company have requested us to discontinue the use of the word "Whale" in connection with our improved ball-bearing I-beam trolley. They contend that it is too easily confused with the name "Yale" which they use on their products.

Of course, in adopting the name "Whale" we had not the slightest intention of trading on their reputation. We called our trolley the "Whale" because it is precisely what the name implies—***a whale of a trolley.*** We, too, have no desire to have it confused with any other, so we have willingly agreed to change the name.

POINTS TO CONSIDER IN SELECTING A NAME

1 Because of its short wheel base, the "Whale" operates almost as easily on curves as on a straightaway. Tests have proved that a boy can operate the one-ton "Whale" even when it is loaded to capacity.

2 Felt washers prevent gritty dust and dirt from reaching the bearings. They also provide perfect lubrication, as the felt absorbs oil from the oil hole and transmits it to the bearings continuously.

3 Another exclusive feature. Bumpers protect all four wheels from shock when trolleys bump together or strike stop at end of track. It is practically impossible for the wheels of the "Whale" to become chipped.

4 Combination and radial thrust bearings are found only in the "Whale." The ball races are ground and the balls themselves are of high duty steel. This feature enables a one-ton load to be started by the pull of a man's little finger.

5 Reduced friction is assured by crowning the wheel treads. Also, the treads are chilled to give maximum hardness and minimum wear. This is another reason why the "Whale" will withstand long years of hard service.

$50.00 for a Name

It occurs to us that you men who know the many superiorities of the "Whale" trolley are best qualified to rename it. To repay you for your trouble, we are offering a cash prize of $50.00 for the most fitting name submitted.

This time we want a name that can't possibly be confused with any other. The "Whale" is so far superior to ordinary trolleys that we wouldn't think of giving it an imitative name. Study the various exclusive features described at the left and see if they don't suggest a name that is as distinctive and strong as the trolley.

Contest Closes Jan. 1, 1923

This contest is open to every person who cares to compete. Only our employees are barred. The President, Secretary-Treasurer and Superintendent of the Richards-Wilcox Manufacturing Company will be the sole judges, and all suggestions should be addressed to us at Aurora. The contest closes January 1, 1923, and the winning name will be announced in this and similar publications as soon after that date as it is possible. In the event of a tie, a $50.00 prize will be awarded to each person submitting the winning name.

Also manufacturers of FyeR-Wall corrugated and tin-clad doors. Automatic fire door hardware, etc.

Richards-Wilcox Mfg. Co.

"A Hanger for any Door that Slides."

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